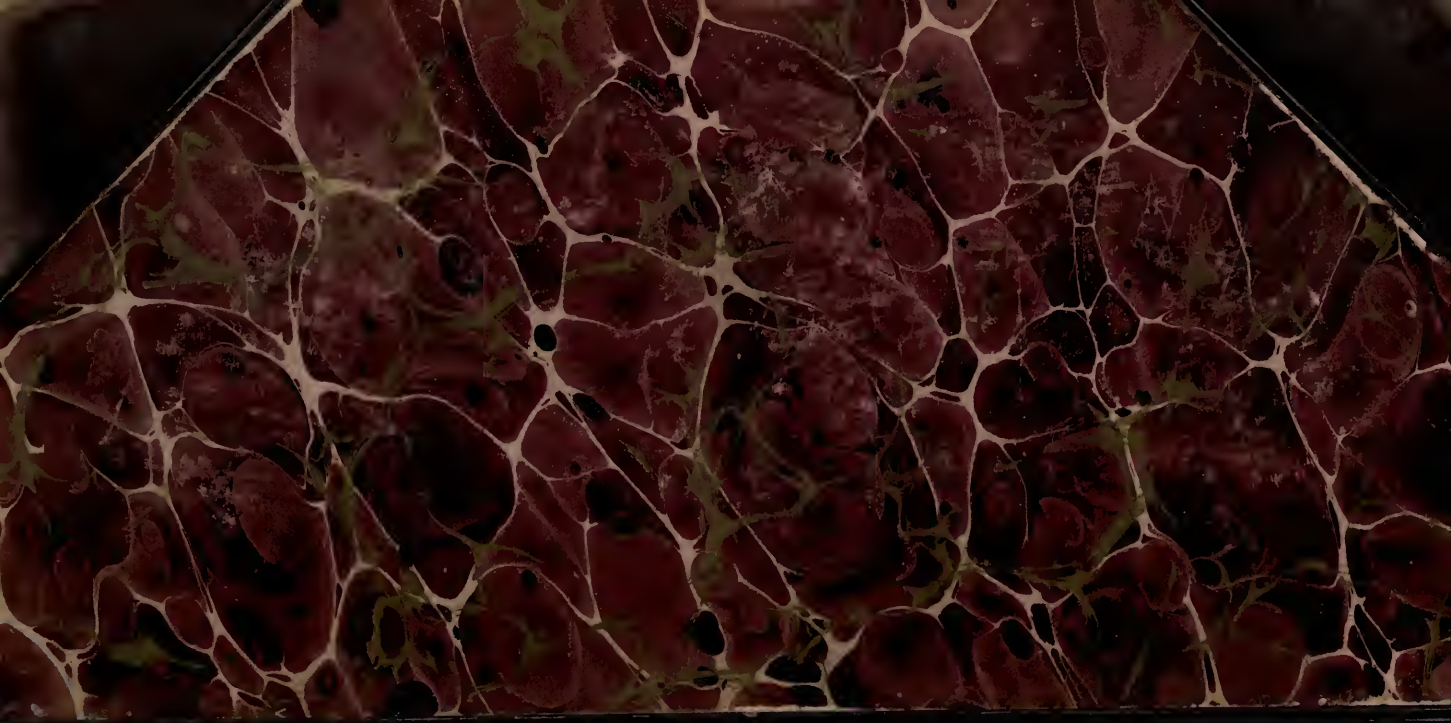

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THE WORKS

OF

FRANCIS BACON.

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Engraved by H. Wright Smith, after an old print by Simon Pass

THE RIGHTE HONOURABLE

Sir Francis Bacon, knight.

LORDE HIGHE CHANCELLOUR OF ENGLAND

[illegible]

THE

WORKS

OF

FRANCIS BACON,

BARON OF VERULAM, VISCOUNT ST. ALBANS, AND
LORD HIGH CHANCELLOR OF ENGLAND.

Collected and Edited

BY

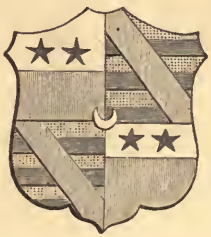
JAMES SPEDDING, M. A.
OF TRINITY COLLEGE, CAMBRIDGE;

ROBERT LESLIE ELLIS, M. A.
LATE FELLOW OF TRINITY COLLEGE, CAMBRIDGE;

AND

DOUGLAS DENON HEATH,
BARRISTER-AT-LAW; LATE FELLOW OF TRINITY COLLEGE, CAMBRIDGE.

VOLUME I.



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HISTORY AND PLAN

OF

THIS EDITION.

BACON'S works were all published separately, and never collected into a body by himself; and though he had determined, not long before his death, to distribute them into consecutive volumes, the order in which they were to succeed each other was confessedly irregular; a volume of moral and political writings being introduced between the first and second parts of the *Instauratio Magna*, quite out of place, merely because he had it ready at the time.[1] In arranging the collected works therefore, every editor must use his own judgment.

Blackbourne, the first editor of an *Opera Omnia*,[2] took the *Distributio Operis* as his groundwork, and endeavoured first to place the various unfinished por-

[1] "Debuerat sequi Novum Organum: interposui tamen Scripta mea Moralia et Politica, quia magis erant in promptu. . . . Atque hic tomus (ut diximus) interjectus est et non ex ordine Instaurationis." — *Ep. ad Fulgentium, Opuscula*, p. 172.

[2] *Francisci Baconi, &c., Opera Omnia, quatuor voluminibus comprehensa.* Londini, MDCCXXX.

tions of the *Instauratio Magna* in the order in which they would have stood had they been completed according to the original design; and then to marshal the rest in such a sequence that they might seem to hang together, each leading by a natural transition to the next, and so connecting themselves into a kind of whole. But the several pieces were not written with a view to any such connexion, which is altogether forced and fanciful; and the arrangement has this great inconvenience — it mixes up earlier writings with later, discarded fragments with completed works, and pieces printed from loose manuscripts found after the author's death with those which were published or prepared for publication by himself. Birch, the original editor of the quarto edition in five volumes[1] which (reprinted in ten volumes octavo) has since kept the market and is now known as the "trade edition," followed Blackbourne's arrangement in the main, — though with several variations which are for the most part not improvements. The arrangement adopted by Mr. Montagu[2] is in these respects no better, in all others much worse. M. Bouillet, in his *Œuvres Philosophiques de François Bacon*,[3] does not profess to include all even of the Philosophical works; and he too, though the best editor by far who has yet handled Bacon, has

[1] The Works of Francis Bacon, &c., in five volumes. London, 1763.

[2] The Works of Francis Bacon, Lord Chancellor of England. A new edition by Basil Montagu, Esq. London, 1825-34.

[3] Paris, 1834.

aimed at a classification of the works more systematic, as it seems to me, than the case admits, and has thus given to some of the smaller pieces a prominence which does not belong to them.

In the edition of which the first volume is here offered to the public, a new arrangement has been attempted; the nature and grounds of which I must now explain.

When a man publishes a book, or writes a letter, or delivers a speech, it is always with a view to some particular audience by whom he means to be understood without the help of a commentator. Giving them credit for such knowledge and capacity as they are presumably furnished with, he himself supplies what else is necessary to make his meaning clear; so that any additional illustrations would be to that audience more of a hindrance than a help. If however his works live into another generation or travel out of the circle to which they were originally addressed, the conditions are changed. He now addresses a new set of readers, differently prepared, knowing much which the others were ignorant of, ignorant of much which the others knew, and on *both* accounts requiring explanations and elucidations of many things which to the original audience were sufficiently intelligible. These it is the proper business of an editor to supply.

This consideration suggested to me, when consulted about a new edition of Bacon, the expediency

of arranging his works with reference — not to subject, size, language, or form — but to the different classes of readers whose requirements he had in view when he composed them. So classified, they will be found to fall naturally into three principal divisions. First, we have his works in philosophy and general literature; addressed to mankind at large, and meant to be intelligible to educated men of all generations. Secondly, we have his works on legal subjects; addressed to lawyers, and presuming in the reader such knowledge as belongs to the profession. Thirdly, we have letters, speeches, charges, tracts, state-papers, and other writings of business; relating to subjects so various as to defy classification, but agreeing in this — they were all addressed to particular persons or bodies, had reference to particular occasions, assumed in the persons addressed a knowledge of the circumstances of the time, and cannot be rightly understood except in relation to those circumstances. In this division every thing will find a place which does not naturally fall into one of the two former; and thus we have the whole body of Bacon's works arranged in three sufficiently distinguishable classes, which may be called for shortness, 1st, The PHILOSOPHICAL and LITERARY; 2nd, The PROFESSIONAL; and 3rd, The OCCASIONAL.

In each of these there is work for an editor to do, but the help he can render differs in the several cases both in nature and amount, and requires qual

ifications differing accordingly. To understand and illustrate the Philosophical works in their relation to this age, a man must be not only well read in the history of science both ancient and modern, but himself a man of science, capable of handling scientific questions. To produce a correct text of the Professional works and supply what other help may be necessary for a modern student, a man must be a lawyer. To explain and interpret the Occasional works, and set them forth in a shape convenient for readers of the present generation, a man must have leisure to make himself acquainted by tedious and minute researches among the forgotten records of the time with the circumstances in which they were written. Now as it would not be easy to find any one man in whom these several qualifications meet, it was thought expedient to keep the three divisions separate, assigning each to a separate editor. It was agreed accordingly that the Philosophical works should be undertaken by Mr. Robert Leslie Ellis; the Professional works by Mr. Douglas Denon Heath; the Occasional and the Literary works by me; each division to be made complete in itself, and each editor to be solely responsible for his own part of the work.

Such was our original arrangement. It was concluded in the autumn of 1847; and Mr. Ellis, whose part was to come first, had already advanced so far that he expected to have it ready for the press with-

in another half year, when unhappily about the end of 1849 he was seized with a rheumatic fever, which left him in a condition of body quite incompatible with a labour of that kind. At which time, though the greater portion was in fact done, he did not consider any of it fit to be published as it was; many blanks having been left to be filled up, and some doubtful notes to be corrected, in that general revision which the whole was to have undergone before any part were printed. It was long before he could finally resolve to abandon his task. As soon as he had done so, he handed all his papers over to me, with permission to do with them whatever I thought best. And hence it is that my name appears in connexion with the Philosophical works; with which otherwise I should not have presumed to meddle.

As soon however as I had arranged and examined his papers, I felt that, however imperfect they might be compared with his own ideal and with what he would himself have made them, they must on no account be touched by anybody else; for that if any other man were allowed to make alterations in them, without notice, according to his own judgment, the reader could have no means of knowing when he was reading the words of Mr. Ellis and when those of his editor, and so their peculiar value would be lost. Perfect or imperfect, it was clear to me that they must be kept as he left them, clear of all alien infusion; and

not knowing of any one who was likely to take so much interest or able to spend so much time in the matter as myself, I proposed to take his part into my own hands and edit it; provided only that I might print his notes and prefaces exactly as I found them; explaining the circumstances which had prevented him from completing or revising them, but making no alteration whatever (unless of errors obviously accidental which I might perhaps meet with in verifying any of the numerous references and quotations) without his express sanction. That the text should be carefully printed from the proper authorities, and all the bibliographical information supplied which was necessary to make the edition in that respect complete, — this I thought I might venture to promise. And although I could not undertake to meddle with purely scientific questions, for which I have neither the acquirements nor the faculties requisite, or to bring any stores of learning, ancient or modern, to bear upon the various subjects of inquiry, — although I had no means, I say, of supplying what he had left to be done in those departments, and must therefore be content to leave the work so far imperfect, — yet in all matters which lay within my compass I promised to do my best to complete the illustration and explanation of the text; adding where I had anything to add, objecting where I had anything to object, but always distinguishing as my own whatever was not his.

To this proposal he agreed, as the best course that

could be taken in the circumstances. Early in 1853 I took the work in hand; and in the three volumes which follow, the reader will find the result.

The things then for which in this division I am to be held responsible are —

1st. All notes and prefaces marked with my initials, and all words inserted between brackets, or otherwise distinguished as mine.

2dly. The general distribution of the Philosophical works into three parts, — whereby all those writings which were either published or intended for publication by Bacon himself as parts of the Great Instauration are (for the first time, I believe) exhibited separately, and distinguished as well from the independent and collateral pieces which did not form part of the main scheme, as from those which, though originally designed for it, were afterwards superseded or abandoned.

3dly. The particular arrangement of the several pieces within each part; which is intended to be according to the order in which they were composed; — a point however which is in most cases very difficult to ascertain.

For the grounds on which I have proceeded in each case, and for whatever else in my part of the work requires explanation, I refer to the places. But there are two or three particulars in which this edition differs from former ones, and which may be more conveniently explained here.

In the third and last division of the entire works, according to the scheme already explained, every authentic writing and every intelligibly reported speech of Bacon's (not belonging to either of the other divisions) which can be found in print or in manuscript will be set forth at full length, each in its due chronological place; with an explanatory narrative running between, in which the reader will be supplied to the best of my skill and knowledge with all the information necessary to the right understanding of them. In doing this, — since the pieces in question are very numerous, and scattered with few and short intervals over the whole of Bacon's life, — I shall have to enter very closely into all the particulars of it; so that this part when finished will in fact contain a complete biography of the man, — a biography the most copious, the most minute, and by the very necessity of the case the fairest, that I can produce; for any material misinterpretation in the commentary will be at once confronted and corrected by the text. The new matter which I shall be able to produce is neither little nor unimportant; but more important than the new matter is the new aspect which (if I may judge of other minds by my own) will be imparted to the old matter by this manner of setting it forth. I have generally found that the history of an obscure transaction becomes clear as soon as the simple facts are set down in the order of their true dates, and most of the difficulties presented by Bacon's life will be found to disappear

when these simple records of it are read in their natural sequence and in their true relation to the business of the time. By this means a great deal of controversy which would disturb and encumber the narrative, and help to keep alive the memory of much ignorant and superficial criticism which had better be forgotten, will I hope be avoided. And until this is done I do not think it desirable to attempt a summary biography in the ordinary form. Such a biography may be easily added, if necessary, in a supplemental volume; but I am persuaded that the best which could be written now would be condemned afterwards as altogether unsatisfactory.

It is true however, that a reader, before entering on the study of an author's works, wants to know something about himself and his life. Now there exists a short memoir of Bacon, which was drawn up by Dr. Rawley in 1657 to satisfy this natural desire, and prefixed to the *Resuscitatio*, and is still (next to Bacon's own writings) the most important and authentic evidence concerning him that we possess. The origin of Dr. Rawley's connexion with Bacon is not known, but it must have begun early. It was in special compliment to Bacon that he was presented on the 18th of January, 1616–17, (being then 28 years old,) to the rectory of Landbeach; a living in the gift of Benet's College, Cambridge.[1] Shortly after, Bacon becoming

[1] "Ad quam præsentatus fuit per honorand. virum Franciscum Bacon mil. Regiæ maj. advocatum generalem, ejusdem vicariæ [rectoriæ] pro hac

Lord-Keeper selected him for his chaplain; and during the last five years of his life, which were entirely occupied with literary business, employed him constantly as a kind of literary secretary. Nor did the connexion cease with life; for after Bacon's death Rawley was intrusted by the executors with the care and publication of his papers. Rawley's testimony must therefore be regarded as that of a witness who, however favourable and affectionate, has the best right to be heard, as speaking not from hearsay but from intimate and familiar knowledge during many years and many changes of fortune; and as being moreover the only man among Bacon's personal acquaintances by whom any of the particulars of his life have been recorded. This memoir, which was printed by Blackbourne, with interpolations from Dugdale and Tenison, and placed in front of his edition of 1730, but is not to be found I think in any more modern edition, I have printed entire in its original shape; adding some notes of my own, by help of which it may serve a modern reader for a sufficient biographical introduction.

The Latin translation of it, published by Rawley in 1658 as an introduction to a little volume entitled *Opuscula Philosophica*, and now commonly prefixed to the *De Augmentis Scientiarum*, I have thought it superfluous to reproduce here; this edition being of little

unica vice, ratione concessionis magistri et sociorum Coll. C. C. (uti asserebatur) patronus." Collections prefixed to Blackbourne's edition 1730, i. 218. Bacon's father was a member and benefactor of Benet's; which accounts for this compliment.

use to those who cannot read English, and the translation being of no use to those who can. And this brings me to the second innovation which I have ventured to introduce.

Bacon had no confidence in the permanent vitality of English as a classical language. "These modern languages," he said, "will at one time or other play the bankrupts with books." Those of his works therefore which he wished to live and which were not originally written in Latin, he translated or caused to be translated into that language — "the universal language," as he called it. This, for his own time, was no doubt a judicious precaution. Appearances however have greatly changed since; and though it is not to be feared that Latin will ever become obsolete, it is certain that English has been rapidly gaining ground upon it, and that of the audience whom Bacon would in these days have especially desired to gather about him, a far greater number would be excluded by the Latin dress than admitted. Considering also the universal disuse of Latin as a medium of oral communication, and the almost universal disuse of it as a medium of communication in writing, even among learned men, and the rapid spreading of English over both hemispheres, it is easy to predict which of the two languages is likely to play the bankrupt first. At any rate the present edition is for the English market. To those who are not masters of English it offers few attractions; while of those who are,

not one I suppose in a hundred would care to read a translation even in Baconian Latin, when he had the choice of reading the original in Baconian English. And since the translations in question would increase the bulk of this work by four or five hundred pages and the cost in proportion, it has been thought better to leave them out.

In one respect, it is true, they have a value independent of the English originals. Having been made later and made under Bacon's own eye, the differences, where they are greater than can be naturally accounted for by the different idiom and construction of the languages, must be considered as corrections; besides which, when the meaning of the original is obscure or the reading doubtful, they serve sometimes as a glossary to decide it. This being an advantage which we cannot afford to sacrifice, I have thought it my duty in all instances to compare the translation carefully with the original, and to quote in foot-notes those passages in which the variation appeared to be material; and as this is a labour which few readers would take upon themselves, I conceive that by the course which I have adopted the English student will be a gainer rather than a loser.

I have also departed from the practice of former editors in not keeping the Latin and English works separate. Such separation is incompatible with the chronological arrangement which I hold to be far preferable. I see no inconvenience in the change

which is at all material; and I only mention it here lest any future publisher, out of regard to a superficial symmetry, should go back to the former practice and so destroy the internal coherency of the present plan.

It may be thought perhaps that in arranging the works which were to form parts of the Great Instauration, I ought to have followed the order laid down in the *Distributio Operis*, marshalling them according to their place in the scheme rather than the date of composition; and therefore that the *De Augmentis Scientiarum* which was meant to stand for the first part, should have been placed before the two books of the *Novum Organum*, which were meant for the commencement of the second. But the truth is that not one of the parts of the Great Instauration was completed according to the original design. All were more or less abortive. In every one of them, the *De Augmentis* and the *Novum Organum* itself not excepted, accidental difficulties, and considerations arising out of the circumstances of the time, interfered more or less with the first intention and induced alterations either in form or substance or both. They cannot be made to fit their places in the ideal scheme. It was the actual conditions of Bacon's life that really moulded them into what they are; and therefore the most natural order in which they can be presented is that in which they stand here; first, the *Distributio Operis*, setting forth the perfect work as he had conceived it in

his mind, and then the series of imperfect and irregular efforts which he made to execute it, in the order in which they were made.

The text has been corrected throughout from the original copies, and no verbal alteration (except in case of obvious errors of the press) has been introduced into it without notice. The spelling in the English works has been altered according to modern usage. I have endeavoured however to distinguish those variations which belong merely to the fashion of orthography from those which appear to involve changes in the forms of words. Thus in such words as *president* (the invariable spelling in Bacon's time of the substantive which is now invariably written *precedent*, and valuable as showing that the pronunciation of the word has not changed), *prœjudice*, *fained*, *mathematiques*, *chymist*, &c., I adopt the modern form; but I do not substitute *lose* for *leese*, *politicians* for *politiques*, *external* for *externe*, *Solomon* for *Salomon*, *accommodated* for the past participle *accommodate;* and so on; these being changes in the words themselves and not merely in the manner of writing them. In the spelling of Latin words there are but few differences between ancient and modern usage; but I have thought it better to preserve the original form of all words which in the original are always or almost always spelt in the same way; as *fœlix*, *author*, *chymista*, *chymicus*, *&c.*

In the matter of punctuation and typography, though I have followed the example of all modern editors in

altering at discretion, I have not attempted to reduce them entirely to the modern form; which I could not have done without sometimes introducing ambiguities of construction, and sometimes deciding questions of construction which admit of doubt. But I have endeavoured to represent the effect of the original arrangement to a modern eye, with as little departure as possible from modern fashions. I say endeavoured; for I cannot say that I have succeeded in satisfying even myself. But to all matters of this kind I have attended personally; and though I must not suppose that my mind has observed everything that my eyes have looked at, I am not without hope that the text of this edition will be found better and more faithful than any that has hitherto been produced.

It was part of our original design to append to the Philosophical works an accurate and readable translation of those originally written in Latin; at least of so much of them as would suffice to give an English reader a complete view of the Baconian philosophy. Mr. Ellis made a selection for this purpose. Arrangements were made accordingly; and a translation of the *Novum Organum* was immediately begun. As successive portions were completed, they were forwarded in the first instance to myself; were by me carefully examined; and then passed on to Mr. Ellis, accompanied with copious remarks and suggestions of my own in the way of correction or improvement. Of these cor-

rections Mr. Ellis marked the greater part for adoption, improved upon others, added many of his own, and then returned the manuscript to be put into shape for the printer. But as he was not able to look over it again after it had received the last corrections, and as the translator did not wish to put his own name to it, and as this edition was to contain nothing for which somebody is not personally responsible, I have been obliged to take charge of it myself. In my final revision I have been careful to preserve all Mr. Ellis's corrections which affect the substance and sense of the translation. In matters which concern only the style and manner of expression, I have thought it better to follow my own taste; a mixture of different styles being commonly less agreeable to the reader, and mine (as the case now stands) being necessarily the predominating one. For the same reason I have altered at discretion the translation of the prefaces, &c. which precede the *Novum Organum;* which were done by another hand, and have not had the advantage of Mr. Ellis's revision. For those which follow, the translator (Mr. Francis Headlam, Fellow of University College, Oxford) will himself be responsible.

Though this volume is already twice as thick as I would have had it, I must add a few words concerning the portraits of Bacon; a subject which has not received the attention which it deserves, and upon which, if picture-dealers and collectors and inheritors

of family portraits would take an interest in it, some valuable light might probably be thrown.

The portrait in the front of the volume is taken from an old engraving by Simon Pass; which came, (as Mr. Smith of Lisle Street informed me, from whom I bought it some years ago,) out of a broken-up copy of Holland's *Baziliologia*.[1] The original has a border, bearing the words HONORATISS : D^S. FRANCISCUS BACON : EQUES AU : MAG : SIGILL : ANGL : CUST^os. Above are his arms, with the motto MONITI MELIORA. Below the chancellor's bag, on which the left hand rests. These accessories, as being presumably the device of the engraver and not suitable to the modern style which has been preferred for the copy, have been dispensed with; but the inscription underneath has been copied verbatim,[2] and enables us to fix the date of the work. Bacon was created Lord Chancellor on the 4th of January, 1617–18, and Baron Verulam on the 12th of the following July; and as it is not to be supposed that his newest title would have been omitted on such an occasion, we

[1] This work was published in 1618; and though one would not expect from the title to find Bacon there, Brunet mentions a copy in the Biblioth. du Roi at Paris "qui, outre les portraits qui composent ordinairement le recueil, renferme encore d'autres portraits du même genre, representants des reines, des princes du sang, et des seigneurs de la cour des Rois Jacques Ier et Charles Ier," &c. The copy in the British Museum has no portrait of Bacon; but as the plates are not numbered, and there is no table of contents, one cannot be sure that any copy is perfect.

[2] The righte Honourable Sr Frauncis Bacon knight, Lorde highe Chancellour of Englande and one of his Maties most hon^ble privie Counsell

may infer with tolerable certainty that the engraving was published during the first half of the year 1618. Below this inscription are engraved in small letters the words "*Simon Passæus sculpsit L. Are to be sould by John Sudbury and George Humble at the signe of the white horse in Pope's head Ally.*" The plate appears to have been used afterwards for a frontispiece to the *Sylva Sylvarum*, which was published in 1627, the year after Bacon's death. At least I have a copy of the second edition of that work (1628) in which the same print is inserted, only with the border and inscription altered; the title which originally surrounded it, together with the Chancellor's bag and the names of the engraver and publishers, being erased; the coat of arms altered; and the words underneath being changed to *The right Honble Francis Lo. Verulam, Viscount St Alban. Mortuus* 9° *Aprilis, Anno Dn̄i* 1626, *Annoq Aetat.* 66. It is probable that the rapid demand for the *Sylva Sylvarum* wore out the plate; for none of the later editions which I have seen contain any portrait at all; and that which was prefixed to the Resuscitatio in 1657, though undoubtedly meant to be a fac-simile of Simon Pass's engraving, has been so much altered in the process of restoration, that I took it for a fresh copy until Mr. Holl showed me that it was only the old plate retouched. The lower part of the face has entirely lost its individuality and physiognomical character; the outline of the right cheek has not been truly followed; that of the nose

has lost its shapeliness and delicacy; and the first line-and-half of the inscription underneath has apparently been erased in order to give the name and titles in Latin. Nevertheless the adoption by Dr. Rawley of this print sufficiently authenticates it as a likeness at that time approved; only the likeness must of course be looked for in the plate as Simon Pass left it, — not in restorations or copies. This Mr. Holl has endeavoured faithfully, and in my opinion very successfully, to reproduce; it being understood however that his aim has been to give as exact a resemblance as he could, not of the old engraving (the style of which has little to recommend it), but of the man whom the engraving represents.

I selected this likeness by preference, partly because original impressions are scarce, and none of the others which I have seen give a tolerable idea of it; whereas the rival portrait by Van Somer is very fairly represented by the engraving in Lodge's collection; but chiefly because I have some reason to suspect that it was made from a painting by Cornelius Janssen, and some hope that the original is still in existence and that this notice may lead to the discovery of it. Janssen is said to have come over to England in 1618, the year in which, as I have said, the engraving must have been published. Bacon did sit for his portrait to somebody (but it may no doubt have been to Van Somer) about that time; at least 33*l*. was "paid to the picture drawer for his Lp's picture," on the 12th of Sep-

tember, 1618.[1] Now I have in my possession an engraving in mezzotinto, purporting to be a portrait of Bacon, representing him in the same position and attitude, and the same dress (only that the figure on the vest is different), and having a similar oval frame with the same kind of border. In the left-hand corner, where the painter's name is usually given, are the words *Cornelius Johnson pinxit.* The engraver's name is not stated; but there is evidence on the face of the work that he was a poor performer. In all points which require accuracy of eye and hand, and a feeling of the form to be described, it differs much from Pass's work, and is very inferior; but in those which the most unskilful artist need never miss, — such as the quantity of face shown, the disposition of the hair, and generally what may be called the *composition* of the picture, — there is no more difference between the two than may be well accounted for by the difficulty which is often found in ascertaining the true outlines of the obscure parts of a dark or damaged picture, or by the alterations which an engraver will often introduce when the size of his plate obliges him to cut off the lower part of the figure. The hat, for instance, which is dark against a dark background, sits differently on the head; sits in fact (in the mezzotint) as it could not possibly have done in nature; and the flap of the brim follows a somewhat different line, though the irregularity is of the same kind; also

[1] See a book of accounts preserved in the State Paper Office.

the light and shadow are differently distributed over the folds of the frill; the fur hangs differently; the figure is cut off too short to admit the hand; and the ribbon round the neck, the lower part of which is concealed in Pass's print, is changed into a George and Garter.[1] But such varieties as these are of ordinary occurrence in copies of the same picture by different hands; especially where one copier is attending chiefly to the outlines of the forms without caring to represent the effect of the picture (the practice I think of engravers in Simon Pass's time), and the other is attending to the effect of the picture without caring, or without being able, to preserve the individual details, according to the practice of the popular engravers of the eighteenth century; whereas in two independent and original portraits of the same face the correspondencies which I have mentioned can hardly occur. But however that may be, this mezzotinto appears at least to prove that when it was made there was in existence a portrait which somebody believed to be a portrait of Bacon by Cornelius Johnson,—that is (no doubt) Cornelius Janssen. When it was made becomes therefore an interesting question; and I regret to say that it is a question which I have no data for determining, beyond the fact that it is in mezzotinto (an art of comparatively modern invention); that it was "sold by J. Cooper in James Street Covent Garden;" and

[1] If the original picture really has this badge, we may conclude, I suppose, that it was not a portrait of Bacon at all. And I should not be very much surprised if it turned out to be a Charles I.

that there was an English engraver called Richard Cooper, who flourished about the year 1763, and among whose engravings a portrait of Francis Bacon Lord Keeper and Chancellor is mentioned as one.[1]

With reference to this subject of portraits, I may add that the various engravings of Bacon are all (with one exception which I will mention presently) derived directly or through successive copies from one or other of two originals. One is Simon Pass's print; the features of which may be traced through many generations of copies, each less like than its predecessor; though always to be identified by the hat with irregular brim curving *upwards* towards the sides, and bound with a scarf. The other is a portrait by Van Somer; the same I suppose that Aubrey saw at Gorhambury in 1656; which has become the parent of two separate families; one wearing a hat with a brim describing a regular curve *downwards* towards the sides, which sufficiently distinguishes it from Pass's portrait; the other without any hat; the composition being in other respects the same. Of both these the originals are at Gorhambury; and they are both ascribed to Van Somer. But the latter is so very inferior to the former in every quality of art, that unless there be some evidence of the fact more to be relied on than an ordinary family tradition, I shall never be able to believe that it is by the same hand. It seems to me far more probable that at some later period when the fash-

[1] See Bryan's *Painters and Engravers*.

ion of painting people with the head covered had gone out, some one, wishing to have a portrait of Bacon without his hat, employed the nearest artist to make a copy of Van Somer's picture (Van Somer himself died in 1621, two or three years after it was painted, about the time when Bacon was in the Tower) with that alteration; and that this is the work he produced. That he was not a skilful artist is sufficiently apparent from the execution of those parts which were intended to be copies; the peculiar character and expression of eyebrows, eyes, nose and mouth, being entirely missed; and the whole handling being weak and poor, and without any sense of form. Moreover the hair is of a different texture; and although we have neither any description nor any drawing of the upper part of Bacon's full-grown head, we know what it was like in his boyhood from two very admirable representations, quite independent of each other and yet exactly agreeing; and it is plain that such a head could never have grown into a shape at all like that which the painter has invented.

However, they were both called portraits by Van Somer; and the first (which is a very good work, as far as the painting goes) was engraved by Houbraken; the last by Vertue. Unfortunately, these two artists, whose style of execution made them very popular and gave them almost a monopoly of English historical portraiture in the 18th century, were both utterly without conscience in the matter of likeness. And though

many of their works are brilliant specimens of effect in line-engraving, yet regarded as likenesses of the men, they are all alike worse than worthless. The original from which Vertue's engraving of Bacon was taken, being itself destitute of all true physiognomical character, is indeed represented well enough. But if any one wishes to form a notion of Bacon's face as interpreted by Van Somer, he must consult the more modern engraving in Lodge's collection, which is at least a conscientious attempt to translate it faithfully; Houbraken's can only mislead him.

The other engraving to which I have alluded as not derived from either of the originals above mentioned, is the small head engraved for Mr. Montagu's edition of Bacon's works. This was taken from a miniature by Hilliard then in the possession of John Adair Hawkins, Esq., representing Bacon in his eighteenth year; a work of exquisite beauty and delicacy. But here also, I regret to say, the laudable attempt to bring an image of it within reach of the general public has been attended with the same infelicity. The engraver has so completely failed to catch either expression, feature, character, or drawing, that I think no one can have once seen the original without wishing, in justice both to subject and artist, that no one who has not seen it may ever see the copy.

Judging from the issue of Mr. Montagu's attempt to obtain an engraving of this miniature, it is perhaps fortunate that he did not fulfil the intention which he

announced of giving an engraving of a bust in terra cotta representing Bacon in his twelfth year, which is at Gorhambury, in the possession of the Earl of Verulam. But this also is a work of great merit, and extremely interesting. It is coloured, and (like Hilliard's miniature) shows the head. I have been told by artists that it is probably of Italian workmanship; and certainly the work of an accomplished sculptor, who had a delicate perception of form and character. A faithful representation of it would be one of the most valuable contributions which could be made to our collections of the faces of memorable men.

There are other portraits of Bacon in existence, but I have not myself seen any which can be relied upon as authentic or which appear to have any independent value. If the foregoing remarks should be the means of bringing any such out of their hiding-places, I shall think them well bestowed; and I need scarcely add that I should be most happy to receive any communication on the subject, and to afford what help I can towards putting them in their true light.

JAMES SPEDDING.

60. Lincoln's Inn Fields, January, 1857.

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THE

LIFE

OF

THE RIGHT HONOURABLE

FRANCIS BACON,

BARON OF VERULAM, VISCOUNT ST. ALBANS.

BY

WILLIAM RAWLEY, D.D.

HIS LORDSHIP'S FIRST AND LAST CHAPLAIN AND OF LATE HIS MAJESTIES CHAPLAIN IN ORDINARY.

[This is the title of an edition printed in 1670, after Dr. Rawley's death, and prefixed to the ninth edition of the *Sylva Sylvarum*. The text of the Life itself is taken from the second edition of the *Resuscitatio*, the latest with which Rawley had anything to do. I have, however, modernised the spelling; altered at discretion the typographical arrangement as to capitals, italics, and punctuation, which is very perplexing to a modern eye and has nothing to recommend it; and added the notes. —*J. S.*]

THE LIFE

OF

THE HONOURABLE AUTHOR.[1]

Francis Bacon, the glory of his age and nation, the adorner and ornament of learning, was born in York House, or York Place, in the Strand, on the two and twentieth day of January, in the year of our Lord 1560. His father was that famous counsellor to Queen Elizabeth, the second prop of the kingdom in his time, Sir Nicholas Bacon, knight, lord-keeper of the great seal of England; a lord of known prudence, sufficiency, moderation, and integrity. His mother was Anne, one of the daughters of Sir Anthony Cook; unto whom the erudition of King Edward the Sixth had been committed; a choice lady, and eminent for piety, virtue, and learning; being exquisitely skilled, for a woman,

[1] This Life was first published in 1657, as an introduction to the volume entitled "Resuscitatio; or bringing into public light several pieces of the works, civil, historical, philosophical, and theological, hitherto sleeping, of the Right Honourable Francis Bacon, Baron of Verulam, Viscount St. Alban; according to the best corrected copies." Of this volume a second edition, or rather a re-issue with fresh titlepage and dedication, and several sheets of new matter inserted, appeared in 1661; the "Life of the Honourable Author" being prefixed as before, and not altered otherwise than by the introduction of three new sentences; to make room for which two leaves were cancelled. A third edition was brought out in 1671 by the original publisher, containing a good deal of new matter; for which however Dr Rawley, who died in 1667, is not answerable.

in the Greek and Latin tongues. These being the parents, you may easily imagine what the issue was like to be; having had whatsoever nature or breeding could put into him.

His first and childish years were not without some mark of eminency; at which time he was endued with that pregnancy and towardness of wit, as they were presages of that deep and universal apprehension which was manifest in him afterward; and caused him to be taken notice of by several persons of worth and place, and especially by the queen; who (as I have been informed) delighted much then to confer with him, and to prove him with questions; unto whom he delivered himself with that gravity and maturity above his years, that Her Majesty would often term him, *The young Lord-keeper*. Being asked by the queen *how old he was*, he answered with much discretion, being then but a boy, *That he was two years younger than Her Majesty's happy reign;* with which answer the queen was much taken.[1]

At the ordinary years of ripeness for the university, or rather something earlier, he was sent by his father to Trinity College, in Cambridge,[2] to be educated and bred under the tuition of Doctor John White-gift, then master of the college; afterwards the renowned archbishop of Canterbury; a prelate of the first magnitude

[1] This last sentence was added in the edition of 1661. The substance of it had appeared before in the Latin Life prefixed to the *Opuscula Philosophica* in 1658, which is only a free translation of this, with a few corrections.

[2] He began to reside in April 1573: was absent from the latter end of August 1574 till the beginning of March, while the plague raged; and left the university finally at Christmas 1575, being then on the point of sixteen. See Whitgift's accounts, printed in the *British Magazine*, vol. xxxii. p 365., and xxxiii. p. 444.

for sanctity, learning, patience, and humility; under whom he was observed to have been more than an ordinary proficient in the several arts and sciences. Whilst he was commorant in the university, about sixteen years of age, (as his lordship hath been pleased to impart unto myself), he first fell into the dislike of the philosophy of Aristotle; not for the worthlessness of the author, to whom he would ever ascribe all high attributes, but for the unfruitfulness of the way; being a philosophy (as his lordship used to say) only strong for disputations and contentions, but barren of the production of works for the benefit of the life of man; in which mind he continued to his dying day.

After he had passed the circle of the liberal arts, his father thought fit to frame and mould him for the arts of state; and for that end sent him over into France with Sir Amyas Paulet then employed ambassador lieger into France;[1] by whom he was after awhile held fit to be entrusted with some message or advertisement to the queen; which having performed with great approbation, he returned back into France again, with intention to continue for some years there. In his absence in France his father the lord-keeper died,[2] having collected (as I have heard of knowing persons) a considerable sum of money, which he had separated, with intention to have made a competent purchase of land for the livelihood of this his youngest son (who was only unprovided for; and though he was the youngest in years, yet he was not the lowest in his

[1] Sir Amyas landed at Calais on the 25th of September 1576, and succeeded Dr. Dale as ambassador in France in the following February. See *Burghley's Diary*, Murdin, pp. 778, 779.

[2] In February 1578–9.

father's affection); but the said purchase being unaccomplished at his father's death, there came no greater share to him than his single part and portion of the money dividable amongst five brethren; by which means he lived in some straits and necessities in his younger years. For as for that pleasant site and manor of Gorhambury, he came not to it till many years after, by the death of his dearest brother, Mr. Anthony Bacon,[1] a gentleman equal to him in height of wit, though inferior to him in the endowments of learning and knowledge; unto whom he was most nearly conjoined in affection, they two being the sole male issue of a second *venter*.

Being returned from travel, he applied himself to the study of the common law, which he took upon him to be his profession;[2] in which he obtained to great excellency, though he made that (as himself said) but as an accessary, and not his principal study. He wrote several tractates upon that subject: wherein, though some great masters of the law did out-go him in bulk, and particularities of cases, yet in the science of the grounds and mysteries of the law he was exceeded by none. In this way he was after awhile sworn of the queen's council learned, extraordinary; a grace (if I err not) scarce known before.[3] He seated himself,

[1] Anthony Bacon died in the spring of 1601. See a letter from Mr. John Chamberlain to Sir Dudley Carlton, in the State Paper Office, dated 27th May 1601.

[2] He had been admitted *de societate mtrorum* of Gray's Inn on the 27th of June 1576; commenced his regular career as a student in 1579; became "utter barrister" on the 27th of June 1582; bencher in 1586; reader in 1588; and double reader in 1600. See Harl. MSS. 1912, and Book of Orders, p. 56.

[3] In the Latin version of this memoir, for "after a while" Rawley substitutes *nondum tyrocinium in lege egressus*, by which he seems to assign a

for the commodity of his studies and practice, amongst the Honourable Society of Gray's-Inn, of which house he was a member; where he erected that elegant pile or structure commonly known by the name of *The Lord Bacon's Lodgings*, which he inhabited by turns the most part of his life (some few years only excepted) unto his dying day. In which house he carried himself with such sweetness, comity, and generosity, that he was much revered and beloved by the readers and gentlemen of the house.

Notwithstanding that he professed the law for his livelihood and subsistence, yet his heart and affection

very early period as the date of this appointment. But I suspect he was mistaken, both as to the date and the nature of it. The title he got no doubt from a letter addressed by Bacon to King James, about the end of January 1620–1. "You found me of the Learned Council, Extraordinary, without patent or fee, a kind of *individuum vagum*. You established me and brought me into Ordinary." Coupling this probably with an early but undated letter to Burghley, in which Bacon thanks the queen for "appropriating him to her service," he imagined that the thanks were for the appointment in question. This however is incredible. A copy of this letter in the Landsdowne Collection gives the date,—18 October 1580; at which time Bacon had not been even a student of law for more than a year and a half, and could not therefore have been qualified for such a place; still less could such a distinction have been conferred upon him without being much talked of at the time and continually referred to afterwards. Moreover, we have another letter of Bacon's to King James, written in 1606, in which he speaks of his "*nine* years' service of the crown." This would give 1597 as the year in which he began to serve as one of the learned council; at which time it was no extraordinary favour, seeing that he had been recommended for solicitor-general three or four years before, both by Burghley and Egerton. It appears however to have been no regular or formal appointment. He was not sworn. He had no patent; not even a written warrant. His tenure was only *ratione verbi regii Elizabethæ* (see Rymer, A. D. 1604, p. 121.). Elizabeth, who "looked that her word should be a warrant," chose to employ him in the business which belonged properly to her learned council, and he was employed accordingly. His first service of that nature,—the first at least of which I find any record,—was in 1594. In 1597 he had come to be employed regularly, and so continued till the end of the reign, and was familiarly spoken of as "Mr. Bacon of the learned council."

was more carried after the affairs and places of estate; for which, if the majesty royal then had been pleased, he was most fit. In his younger years he studied the service and fortunes (as they call them) of that noble but unfortunate earl, the Earl of Essex; unto whom he was, in a sort, a private and free counsellor, and gave him safe and honourable advice, till in the end the earl inclined too much to the violent and precipitate counsel of others his adherents and followers; which was his fate and ruin.[1]

His birth and other capacities qualified him above others of his profession to have ordinary accesses at court, and to come frequently into the queen's eye, who would often grace him with private and free communication, not only about matters of his profession or business in law, but also about the arduous affairs of estate; from whom she received from time to time great satisfaction. Nevertheless, though she cheered him much with the bounty of her countenance, yet she never cheered him with the bounty of her hand; having never conferred upon him any ordinary place or

[1] The connexion between Bacon and Essex appears to have commenced about the year 1590 or 1591, and furnishes matter for a long story — too long to be discussed in a note. His conduct was much misunderstood at the time by persons who had no means of knowing the truth, and has been much misrepresented since by writers who cannot plead that excuse. The case is not however one on which a unanimous verdict can be expected. Always, where choice has to be made between fidelity to the state and fidelity to a party or person, popular sympathy will run in favour of the man who chooses the narrower duty; for the narrower duty is not only easier to comprehend, but, being seen closer, *appears* the larger of the two. But though sentiments will continue to be divided, facts may be agreed upon; and for the correction of all errors in matter of fact, I must refer to the Occasional Works, where the whole story will necessarily come out in full detail. In the mean time I may say for myself that I have no fault to find with Bacon for any part of his conduct towards Essex, and I think many people will agree with me when they see the case fairly stated.

means of honour or profit, save only one dry reversion of the Register's Office in the Star Chamber, worth about 1600*l. per annum*, for which he waited in expectation either fully or near twenty years;[1] of which his lordship would say in Queen Elizabeth's time, *That it was like another man's ground buttalling upon his house, which might mend his prospect, but it did not fill his barn;* (nevertheless, in the time of King James it fell unto him); which might be imputed, not so much to Her Majesty's averseness and disaffection towards him, as to the arts and policy of a great statesman then, who laboured by all industrious and secret means to suppress and keep him down; lest, if he had risen, he might have obscured his glory.[2]

But though he stood long at a stay in the days of his mistress Queen Elizabeth, yet after the change, and coming in of his new master King James, he made a great progress; by whom he was much comforted in places of trust, honour, and revenue. I have seen a letter of his lordship's to King James, wherein he makes acknowledgment, *That he was that master to him, that had raised and advanced him nine times; thrice in dignity, and six times in office.* His offices (as I conceive) were Counsel Learned Extraordinary[3] to

[1] The reversion, for which he considered himself indebted to Burghley, was granted to him in October 1589. He succeeded to the office in July 1608. In the Latin version Rawley adds that he administered it by deputy.

[2] The person here alluded to is probably his cousin Robert Cecil, who, though he always professed an anxiety to serve him, was supposed (apparently not without reason) to have thrown obstacles secretly in the way of his advancement.

[3] See note 3. p. 38. Rawley should rather have said "counsel learned, *no longer extraordinary.*" It is true indeed that King James did at his first entrance confirm Bacon by warrant under the sign manual in the same office which he had held under Elizabeth by special commandment. But it was the "establishing him and bringing him into *ordinary*" with a sal-

His Majesty, as he had been to Queen Elizabeth; King's Solicitor-General; His Majesty's Attorney-General; Counsellor of Estate, being yet but Attorney; Lord-Keeper of the Great Seal of England; lastly, Lord Chancellor; which two last places, though they be the same in authority and power, yet they differ in patent, height, and favour of the prince; since whose time none of his successors, until this present honourable lord,[1] did ever bear the title of Lord Chancellor. His dignities were first Knight, then Baron of Verulam; lastly, Viscount St. Alban; besides other good gifts and bounties of the hand which His Majesty gave him, both out of the Broad Seal and out of the Alienation Office,[2] to the value in both of eighteen hundred pounds per annum; which, with his manor of Gorhambury, and other lands and possessions near thereunto adjoining, amounting to a third part more, he retained to his dying day.

Towards his rising years, not before, he entered into a married estate, and took to wife Alice, one of the daughters and coheirs of Benedict Barnham, Esquire and Alderman of London; with whom he received a sufficiently ample and liberal portion in marriage.[3] Children he had none; which, though they be the

ary of 40*l.*, which he reckons as first in the series of advancements. This was in 1604. He was made solicitor in 1607, attorney in 1613, counsellor of state in 1616, lord-keeper in 1617, lord chancellor in 1618. His successive dignities were conferred respectively in 1603, 1618, and 1620–1.

[1] Sir Edward Hyde, made Lord Chancellor June 1. 1660. This clause was added in 1661; the leaf having been cancelled for the purpose.

[2] Here the paragraph ended in the first edition. The rest was added in 1671.

[3] It appears, from a manuscript preserved in Tenison's Library, that he had about 220*l.* a-year with his wife, and upon her mother's death was to have about 140*l.* a-year more.

means to perpetuate our names after our deaths, yet he had other issues to perpetuate his name, the issues of his brain; in which he was ever happy and admired, as Jupiter was in the production of Pallas. Neither did the want of children detract from his good usage of his consort during the intermarriage, whom he prosecuted with much conjugal love and respect, with many rich gifts and endowments, besides a robe of honour which he invested her withal; which she wore unto her dying day, being twenty years and more after his death.[1]

The last five years of his life, being withdrawn from civil affairs[2] and from an active life, he employed

[1] By the "robe of honour" is meant, I presume, the title of viscountess. It appears however that a few months before Bacon's death his wife had given him some cause of grave offence. Special provision is made for her in the body of his will, but revoked in a codicil, "for just and great causes," the nature of which is not specified. Soon after his death she married Sir John Underwood, her gentleman-usher. She was buried at Eyworth in Bedfordshire on the 29th of June 1650.

[2] On the 3rd of May 1621, Bacon was condemned, upon a charge of corruption to which he pleaded guilty, to pay a fine of 40,000*l.*; to be imprisoned in the Tower during the king's pleasure; to be for ever incapable of sitting in parliament or holding office in the state; and to be banished for life from the verge of the court. From that time his only business was to find means of subsistence and of satisfying his creditors, and to pursue his studies.

His offence was the taking of presents from persons who had suits in his court, in some cases while the suit was still pending; an act which undoubtedly amounted to corruption as corruption was defined by the law. The degree of *moral* criminality involved in it is not so easily ascertained. To judge of this, we should know, First, what was the understanding, open or secret, upon which the presents were given and taken, — for a gift, though it be given to a judge, is not necessarily in the nature of a bargain to pervert justice: Secondly, to what extent the practice was prevalent at the time, — for it is a rare virtue in a man to resist temptations to which all his neighbours yield: Thirdly, how far it was *tolerated*, — for a practice may be universally condemned and yet universally tolerated; people may be known to be guilty of it and yet received in society all the same Fourthly, how it stood with regard to other abuses prevailing at the same time, — for it is hard to reform all at once, and it is one thing for a man to leave a single abuse unreformed while he is labouring to remove or resist

wholly in contemplation and studies — a thing whereof his lordship would often speak during his active life, as if he affected to die in the shadow and not in the light; which also may be found in several passages of his works. In which time he composed the greatest part of his books and writings, both in English and Latin, which I will enumerate (as near as I can) in the just order wherein they were written:[1] — *The History of the Reign of King Henry the Seventh; Abeceda-*

greater ones, and another thing to introduce it anew, or to leave all as it was, making no effort to remove any. Now all this is from the nature of the case very difficult to ascertain. But the whole question, as it regards Bacon's character, must be considered in connexion with the rest of his political life, and will be fully discussed in its place in the Occasional works; where all the evidence I can find shall be faithfully exhibited. In this place it may be enough to say that he himself always admitted the taking of presents as he had taken them to be indefensible, the sentence to be just, and the example salutary; and yet always denied that he had been an unjust judge, or "had ever had bribe or reward in his eye or thought when he pronounced any sentence or order;" and that I cannot find any reason for doubting that this was true. It is stated, indeed, in a manuscript of Sir Matthew Hale's, published by Hargrave, that the censure of Bacon "for many decrees made upon most gross bribery and corruption . . . . gave such a discredit and brand to the decrees thus obtained that they were easily set aside;" and it is true that some bills were brought into the House of Commons *for the purpose* of setting aside such decrees; but I cannot find that any one of them reached a third reading; and it is clear from Sir Matthew's own argument that he could not produce an instance of one reversed by the House of Lords; and if any had been reversed by a royal commission appointed for the purpose (which according to his statement was the only remaining way), it must surely have been heard of; yet where is the record of any such commission? Now if of all the decrees so discredited none were reversed, it is difficult to resist the conclusion that they had all been made *bonâ fide* with regard only to the merits of the cases, and were in fact unimpeachably just; and we may believe that Bacon pronounced a true judgment on his own case when he said to his friends (as I find it recorded in a commonplace book of Dr. Rawley's in the Lambeth Library), "I was the justest judge that was in England these fifty years; but it was the justest censure in parliament that was these two hundred years."

[1] In the Latin version Rawley adds, *quam præsens observavi;* which gives this list a peculiar value.

rium Naturæ, or a Metaphysical piece which is lost;[1] *Historia Ventorum; Historia Vitæ et Mortis; Historia Densi et Rari*, not yet printed;[2] *Historia Gravis et Levis*, which is also lost;[3] *a Discourse of a War with Spain; a Dialogue touching an Holy War; the Fable of the New Atlantis; a Preface to a Digest of the Laws of England; the beginning of the History of the Reign of King Henry the Eighth; De Augmentis Scientiarum* or the Advancement of Learning, put into Latin,[4] with several enrichments and enlargements; *Counsels Civil and Moral*, or his book of *Essays*, likewise enriched and enlarged; *the Conversion of certain Psalms into English Verse; the Translation into Latin of the History of King Henry the Seventh, of the Counsels Civil and Moral*,[5] *of*

[1] A fragment of this piece was recovered and printed by Tenison in the *Baconiana;* and will appear in this edition* after the *Historia Ventorum*, which it was intended to accompany.

[2] This was true in 1657; but it was printed the next year in the *Opuscula Philosophica;* and, therefore, for "not yet printed," the Latin version substitutes *jam primum typis mandata.* In the edition of 1661 a corresponding alteration ought to have been made in the English, but was not; and as the words occur in one of the cancelled leaves they must have been left by oversight.

[3] This was probably the tract which Gruter says he once had in his hands, and which he describes as merely a skeleton, exhibiting heads of chapters not filled up. "*De Gravi et Levi in manibus habui integrum et grande volumen, sed quod, præter nudam delineatæ fabricæ compagem ex titulis materiam prout eam conceperat Baconus absolventibus, nihil descriptionis continebat.*" See his letter to Rawley, May 29. 1652, in the *Baconiana*, p. 223.

[4] In this edition* I have placed the *De Augmentis* before the *Historia Ventorum;* because, though published after, it was prepared and arranged, and in that sense composed, before. And in this view I am supported by a slight variation which is introduced here in the Latin version, viz. "Intervenerat *opus de Augmentis Scientiarum*," &c.

We learn also from the Latin version that Bacon worked at the translation of the *Advancement of Learning* himself: *in quo e linguâ vernaculâ*, proprio Marte, *in Latinam transferendo honoratissimus auctor plurimum desudavit.*

[5] These were the Essays as they appeared in the third and last edition

the Dialogue of the Holy War, *of the Fable of the New Atlantis*, for the benefit of other nations;[1] his revising of his book *De Sapientiâ Veterum; Inquisitio de Magnete; Topica Inquisitionis de Luce et Lumine;* both these not yet printed;[2] lastly, *Sylva Sylvarum*, or *the Natural History*. These were the fruits and productions of his last five years. His lordship also designed, upon the motion and invitation of his late majesty, to have written the reign of King Henry the Eighth; but that work perished in the designation merely, God not lending him life to proceed farther upon it than only in one morning's work; whereof there is extant an *ex ungue leonem*, already printed in his lordship's *Miscellany Works*.

There is a commemoration due as well to his abilities and virtues as to the course of his life. Those abilities which commonly go single in other men, though of prime and observable parts, were all conjoined and met in him. Those are, *sharpness of wit*, *memory*, *judgment*, and *elocution*. For the former three his books do abundantly speak them; which[3] with what sufficiency he wrote, let the world judge; but with what celerity he wrote them, I can best testify. But for the fourth, his *elocution*, I will only set down what I heard Sir Walter Raleigh once speak of

but he gave them a weightier title when he had them translated into "the general language:" *exinde dicti, sermones fideles, sive interiora rerum.*

[1] The Latin version adds, *apud quos expeti audiverat.*

[2] These words are omitted in the Latin version, and must have been left by oversight in the edition of 1661; for they occur in one of the cancelled leaves; and the works in question had been printed in 1658. The error is the more worth noticing because it shows that wherever the English and the Latin differ, the Latin must be regarded as the later and better authority.

[3] The Latin version adds, *ut de Julio Cæsare Hirtius.*

him by way of comparison (whose judgment may well be trusted), *That the Earl of Salisbury was an excellent speaker, but no good penman; that the Earl of Northampton (the Lord Henry Howard) was an excellent penman, but no good speaker; but that Sir Francis Bacon was eminent in both.*

I have been induced to think, that if there were a beam of knowledge derived from God upon any man in these modern times, it was upon him. For though he was a great reader of books, yet he had not his knowledge from books,[1] but from some grounds and notions from within himself; which, notwithstanding, he vented with great caution and circumspection. His book of *Instauratio Magna*[2] (which in his own account was the chiefest of his works) was no slight imagination or fancy of his brain, but a settled and concocted notion, the production of many years' labour and travel. I myself have seen at the least twelve copies of the *Instauration*, revised year by year one after another, and every year altered and amended in the frame thereof, till at last it came to that model in which it was committed to the press; as many living creatures do lick their young ones, till they bring them to their strength of limbs.

In the composing of his books he did rather drive at a masculine and clear expression than at any fineness or affectation of phrases, and would often ask if the

[1] *i. e.* not from books *only: Ex libris tamen solis scientiam suam deprompsisse haudquaquam concedere licet.*

[2] For *Instauratio Magna* in this place, and also for *Instauration* a few lines further on, the Latin version substitutes *Novum Organum.* Rawley when he spoke of the *Instauration*, was thinking, no doubt, of the volume in which the *Novum Organum* first appeared, and which contains all the pieces that stand in this edition [Complete Works] before the *De Augmentis.*

meaning were expressed plainly enough, as being one that accounted words to be but subservient or ministerial to matter, and not the principal. And if his style were polite,[1] it was because he would do no otherwise. Neither was he given to any light conceits, or descanting upon words, but did ever purposely and industriously avoid them; for he held such things to be but digressions or diversions from the scope intended, and to derogate from the weight and dignity of the style.

He was no plodder upon books; though he read much, and that with great judgment, and rejection of impertinences incident to many authors; for he would ever interlace a moderate relaxation of his mind with his studies, as walking, or taking the air abroad in his coach,[2] or some other befitting recreation; and yet he would lose no time, inasmuch as upon his first and immediate return he would fall to reading again, and so suffer no moment of time to slip from him without some present improvement.

His meals were refections of the ear as well as of the stomach, like the *Noctes Atticæ*, or *Convivia Deipnosophistarum*, wherein a man might be refreshed in his mind and understanding no less than in his body. And I have known some, of no mean parts, that have professed to make use of their note-books when they have risen from his table. In which conversations, and otherwise, he was no dashing man,[3] as some men

[1] The Latin version adds: *Siquidem apud nostrates eloquii Anglicani artifex habitus est.*

[2] In the Latin version Rawley adds gentle exercise on horseback and playing at bowls: *Equitationem, non citam sed lentam, globorum lusum, et ia genus exercitia.*

[3] The word *dash* is used here in the same sense in which Costard uses it in *Love's Labour's Lost:* "There, an't please you; a foolish, mild man; an

are, but ever a countenancer and fosterer of another man's parts. Neither was he one that would appropriate the speech wholly to himself, or delight to outvie others, but leave a liberty to the co-assessors to take their turns. Wherein he would draw a man on and allure him to speak upon such a subject, as wherein he was peculiarly skilful, and would delight to speak. And for himself, he contemned no man's observations, but would light his torch at every man's candle.

His opinions and assertions were for the most part binding, and not contradicted by any; rather like oracles than discourses; which may be imputed either to the well weighing of his sentence by the scales of truth and reason, or else to the reverence and estimation wherein he was commonly had, that no man would contest with him; so that there was no argumentation, or *pro* and *con* (as they term it), at his table: or if there chanced to be any, it was carried with much submission and moderation.

I have often observed, and so have other men of great account, that if he had occasion to repeat another man's words after him, he had an use and faculty to dress them in better vestments and apparel than they had before; so that the author should find his own speech much amended, and yet the substance of it still retained;[1] as if it had been natural to him to

honest man, look you, and soon *dashed:*" Rawley means that Bacon was not a man who used his wit, as some do, to put his neighbours out of countenance: *Convivantium neminem aut alios colloquentium* pudore suffundere *gloriæ sibi duxit, sicut nonnulli gestiunt.*

[1] This is probably the true explanation of a habit of Bacon's which seems at first sight a fault, and perhaps sometimes is; and of which a great many instances have been pointed out by Mr. Ellis; — a habit of inaccurate quotation. In quoting an author's words, — especially where he quotes them merely by way of voucher for his own remark, or in acknowledgment

use good forms, as Ovid spake of his faculty of versifying,

"Et quod tentabam scribere, versus erat."

When his office called him, as he was of the king's council learned, to charge any offenders, either in criminals or capitals, he was never of an insulting and domineering nature over them, but always tender-hearted, and carrying himself decently towards the parties (though it was his duty to charge them home), but yet as one that looked upon the *example* with the eye of severity, but upon the *person* with the eye of pity and compassion. And in civil business, as he was counsellor of estate, he had the best way of advising, not engaging his master in any precipitate or grievous courses, but in moderate and fair proceedings: the king whom he served giving him this testimony, *That he ever dealt in business* suavibus modis; *which was the way that was most according to his own heart.*

Neither was he in his time less gracious with the subject than with his sovereign. He was ever acceptable to the House of Commons [1] when he was a mem-

of the source whence he derived it, or to suggest an allusion which may give a better effect to it, — he very often quotes inaccurately. Sometimes, no doubt, this was unintentional, the fault of his memory; but more frequently, I suspect, it was done deliberately, for the sake of presenting the substance in a better form, or a form better suited to the particular occasion. In citing the evidence of witnesses, on the contrary, in support of a narrative statement or an argument upon matter of fact, he is always very careful.

[1] The Latin version adds, *in quo sæpe peroravit, non sine magno applausu*; a statement of the truth of which abundant evidence may be found in all the records which remain of the proceedings of the House of Commons The first parliament in which he sate was that of 1584: after which he sate in every parliament that was summoned up to the time of his fall.

As an edition of Bacon would hardly be complete unless it contained Ben Jonson's famous description of his manner of speaking, I shall insert it here: — "Yet there happened in my time one noble speaker, who was

ber thereof. Being the king's attorney, and chosen to a place in parliament, he was allowed and dispensed with to sit in the House; which was not permitted to other attorneys.

And as he was a good servant to his master, being never in nineteen years' service (as himself averred) rebuked by the king for anything relating to His Majesty, so he was a good master to his servants, and rewarded their long attendance with good places freely[1] when they fell into his power; which was the cause that so many young gentlemen of blood and quality sought to list themselves in his retinue. And if he were abused by any of them in their places, it was only the error of the goodness of his nature, but the badges of their indiscretions and intemperances.

This lord was religious: for though the world be apt to suspect and prejudge great wits and politics to have somewhat of the atheist, yet he was conversant with God, as appeareth by several passages throughout the whole current of his writings. Otherwise he should have crossed his own principles, which were, *That a little philosophy maketh men apt to forget God, as attributing too much to second causes; but depth of philosophy bringeth a man back to God again.* Now I

full of gravity in his speaking. His language (where he could spare or pass by a jest) was nobly censorious. No man ever spake more neatly, more pressly, more weightily, or suffered less emptiness, less idleness, in what he uttered. No member of his speech but consisted of his own graces. His hearers could not cough, or look aside from him, without loss. He commanded where he spoke; and had his judges angry and pleased at his devotion. No man had their affections more in his power. The fear of every man that heard him was, lest he should make an end.' — *Discoveries:* under title *Dominus Verulamius.*

[1] *Gratis*, in the Latin version; *i. e.* without taking any money for them; an unusual thing in Bacon's time, when the sale of offices was a principal source of all great men's incomes.

am sure there is no man that will deny him, or account otherwise of him, but to have him been a deep philosopher. And not only so; but he was able *to render a reason of the hope which was in him*, which that writing of his of the *Confession of the Faith* doth abundantly testify. He repaired frequently, when his health would permit him, to the service of the church, to hear sermons, to the administration of the sacrament of the blessed body and blood of Christ; and died in the true faith, established in the church of England.

This is most true — he was free from malice, which (as he said himself) *he never bred nor fed.*[1] He was no revenger of injuries; which if he had minded, he had both opportunity and place high enough to have done it. He was no heaver of men out of their places, as delighting in their ruin and undoing. He was no defamer of any man to his prince. One day, when a great statesman was newly dead, that had not been his friend, the king asked him, *What he thought of that lord which was gone?* he answered, *That he would never have made His Majesty's estate better, but he was sure*

[1] "He said he had breeding swans and feeding swans; but for malice, he neither bred it nor fed it." From a commonplace book of Dr. Rawley's in the Lambeth Library. "Et posso dir," says Sir Tobie Matthew, in his dedication to Cosmo de' Medici of an Italian translation of the *Essays* and *Sapientia Veterum*, 1618, "et posso dir con verità (per haver io havute l'honore di pratticarlo molti anni, et quando era *in minoribus*, et hora quando sta in colmo et fiore della sua grandezza) di non haver mai scoperto in lui animo di vendetta, per qualsivoglia aggravio che se gli fosse fatto; nè manco sentito uscirgli di bocca parola d' ingiuria contra veruno che mi paresse venire da passione contra la tal persona; ma solo (et questo ancora molto scarsamente) per giudicio fattone in sangue freddo. Non è già la sua grandezza quel che io ammiro, ma la sua virtù; non sono li favori fattimi da lui (per infiniti che siano) che mi hanno posto il cuore in questi ceppi et catene in che mi ritrovo; ma si bene il suo procedere in commune; che se egli fosse di conditione inferiore, non potrei manco honorarlo se mi fosse nemico io dovrei con tutto ciò amar et procurar di servirlo."

he would have kept it from being worse; which was the worst he would say of him: which I reckon not among his moral, but his Christian virtues.

His fame is greater and sounds louder in foreign parts abroad, than at home in his own nation; thereby verifying that divine sentence, *A prophet is not without honour, save in his own country, and in his own house.* Concerning which I will give you a taste only, out of a letter written from Italy (the storehouse of refined wits) to the late Earl of Devonshire, then the Lord Candish: *I will expect the new essays of my Lord Chancellor Bacon, as also his History, with a great deal of desire, and whatsoever else he shall compose: but in particular of his History I promise myself a thing perfect and singular, especially in Henry the Seventh, where he may exercise the talent of his divine understanding. This lord is more and more known, and his books here more and more delighted in; and those men that have more than ordinary knowledge in human affairs, esteem him one of the most capable spirits of this age; and he is truly such.* Now his fame doth not decrease with days since, but rather increase. Divers of his works have been anciently and yet lately translated into other tongues, both learned and modern, by foreign pens. Several persons of quality, during his lordship's life, crossed the seas on purpose to gain an opportunity of seeing him and discoursing with him; whereof one carried his lordship's picture from head to foot[1] over with him into France, as a thing which he foresaw would be much desired there, that so they might enjoy the image of his person as well as the images of his brain, his books. Amongst the rest, Marquis

[1] This picture was presented to him by Bacon himself, according to the Latin version.

Fiat, a French nobleman, who came ambassador into England, in the beginning of Queen Mary, wife to King Charles, was taken with an extraordinary desire of seeing him; for which he made way by a friend; and when he came to him, being then through weakness confined to his bed, the marquis saluted him with this high expression, *That his lordship had been ever to him like the angels; of whom he had often heard, and read much of them in books, but he never saw them.* After which they contracted an intimate acquaintance, and the marquis did so much revere him, that besides his frequent visits, they wrote letters one to the other, under the titles and appellations of father and son. As for his many salutations by letters from foreign worthies devoted to learning, I forbear to mention them, because that is a thing common to other men of learning or note, together with him.

But yet, in this matter of his fame, I speak in the comparative only, and not in the exclusive. For his reputation is great in his own nation also, especially amongst those that are of a more acute and sharper judgment; which I will exemplify but with two testimonies and no more. The former, when his *History of King Henry the Seventh* was to come forth, it was delivered to the old Lord Brook, to be perused by him; who, when he had dispatched it, returned it to the author with this eulogy, *Commend me to my lord, and bid him take care to get good paper and ink, for the work is incomparable.* The other shall be that of Doctor Samuel Collins, late provost of King's College in Cambridge, a man of no vulgar wit, who affirmed unto me,[1] *That when he had read the book of the*

[1] In the Latin version Rawley has thought it worth while to add that this may have been said playfully: *Sive festive sive serio.*

Advancement of Learning, he found himself in a case to begin his studies anew, and that he had lost all the time of his studying before.

It hath been desired, that something should be signified touching his diet, and the regimen of his health, of which, in regard of his universal insight into nature, he may perhaps be to some an example. For his diet, it was rather a plentiful and liberal diet, as his stomach would bear it, than a restrained; which he also commended in his book of the *History of Life and Death.* In his younger years he was much given to the finer and lighter sort of meats, as of fowls, and such like; but afterward, when he grew more judicious,[1] he preferred the stronger meats, such as the shambles afforded, as those meats which bred the more firm and substantial juices of the body, and less *dissipable;* upon which he would often make his meal, though he had other meats upon the table. You may be sure he would not neglect that himself, which he so much extolled in his writings, and that was the use of nitre; whereof he took in the quantity of about three grains in thin warm broth every morning, for thirty years together next before his death. And for physic, he did indeed live physically, but not miserably; for he took only a maceration of rhubarb,[2] infused into a draught of white wine and beer mingled together for the space of half an hour, once in six or seven days, immediately before his meal (whether dinner or supper), that it might dry the body less; which (as he said) did carry away frequently the grosser humours

[1] More judicious (that is) by experience and observation: *experientiâ edoctus* is the expression in the Latin version.

[2] In the Latin version Rawley gives the quantity: *Rhabarbari sesquitrachmam.*

of the body, and not diminish or carry away any of the spirits, as sweating doth. And this was no grievous thing to take. As for other physic, in an ordinary way (whatsoever hath been vulgarly spoken) he took not. His receipt for the gout, which did constantly ease him of his pain within two hours, is already set down in the end of the *Natural History*.

It may seem the moon had some principal place in the figure of his nativity: for the moon was never in her passion, or eclipsed,[1] but he was surprised with a sudden fit of fainting; and that, though he observed not nor took any previous knowledge of the eclipse thereof; and as soon as the eclipse ceased, he was restored to his former strength again.

He died on the ninth day of April in the year 1626,

[1] Lord Campbell (who appears to have read Rawley's memoir only in the Latin, where the words are *quoties luna* defecit *sive eclipsin passa est*), supposing *defecit* to mean *waned*, discredits this statement, on the ground that "no instance is recorded of Bacon's having fainted in public, or put off the hearing of any cause on account of *the change of the moon*, or of any approaching eclipse, visible or invisible." And it is true that if *defectus lunæ* meant a change of the moon, or even a dark moon (which it might have meant well enough if the Romans had not chosen to appropriate the word to quite another meaning), the accident must have happened in public too often to pass unnoticed. But Rawley was too good a scholar to misapply so common a word in that way. He evidently speaks of eclipses only, and of eclipses visible at the place. Now it is not at all likely that lunar eclipses visible at Westminster would have coincided with important business in which Bacon was conspicuously engaged, often enough (even if he did faint every time) to establish a connexion between the two phenomena. Of course Rawley's statement is not sufficient to prove the reality of any such connexion; but there is no reason to suppose it an invention, and the fact of the fainting-fits may be fairly taken, I think as evidence of the extreme delicacy of Bacon's temperament, and its sensibility to the skiey influences. That Bacon himself never alluded to this relation between himself and the moon is easily accounted for by supposing that he was not satisfied of the fact. He may have observed the coincidence, and mentioned it to Rawley; and Rawley (whose commonplace book proves that he had a taste for astrology) may have believed in the physical connexion, though Bacon himself did not.

the early morning of the day then celebrated for our Saviour's resurrection, in the sixty-sixth year of his age, at the Earl of Arundel's house in Highgate, near London, to which place he casually repaired about a week before; God so ordaining that he should die there of a gentle fever, accidentally accompanied with a great cold, whereby the defluxion of rheum fell so plentifully upon his breast, that he died by suffocation; and was buried in St. Michael's church at St. Albans; being the place designed for his burial by his last will and testament, both because the body of his mother was interred there, and because it was the only church then remaining within the precincts of old Verulam: where he hath a monument erected for him in white marble (by the care and gratitude of Sir Thomas Meautys, knight, formerly his lordship's secretary, afterwards clerk of the King's Honourable Privy Council under two kings); representing his full portraiture in the posture of studying, with an inscription composed by that accomplished gentleman and rare wit, Sir Henry Wotton.[1]

FRANCISCUS BACON, BARO DE VERULAM, S^t. ALBANI VIC^mes,
SEU NOTIORIBUS TITULIS
SCIENTIARUM LUMEN FACUNDIÆ LEX
SIC SEDEBAT.

QUI POSTQUAM OMNIA NATURALIS SAPIENTIÆ
ET CIVILIS ARCANA EVOLVISSET
NATURÆ DECRETUM EXPLEVIT
COMPOSITA SOLVANTUR
AN. DNI M.DC.XXVI.
ÆTAT^is LXVI.

TANTI VIRI
MEM.
THOMAS MEAUTUS
SUPERSTITIS CULTOR
DEFUNCTI ADMIRATOR

But howsoever his body was mortal, yet no doubt his memory and works will live, and will in all probability last as long as the world lasteth. In order to which I have endeavoured (after my poor ability) to do this honour to his lordship, by way of conducing to the same.

FINIS.

PHILOSOPHICAL WORKS.

PART I.

GENERAL PREFACE TO THE PHILOSOPHICAL WORKS, AND PREFACE TO THE NOVUM ORGANUM.

BY

ROBERT LESLIE ELLIS.

GENERAL PREFACE

TO

BACON'S PHILOSOPHICAL WORKS.

BY ROBERT LESLIE ELLIS.

(1.) Our knowledge of Bacon's method is much less complete than it is commonly supposed to be. Of the *Novum Organum*, which was to contain a complete statement of its nature and principles, we have only the first two books; and although in other parts of Bacon's writings, as for instance in the *Cogitata et Visa de Interpretatione Naturæ*, many of the ideas contained in these books recur in a less systematic form, we yet meet with but few indications of the nature of the subjects which were to have been discussed in the others. It seems not improbable that some parts of Bacon's system were never perfectly developed even in his own mind. However this may be, it is certain that an attempt to determine what his method, taken as a whole, was or would have been, must necessarily involve a conjectural or hypothetical element; and it is, I think, chiefly because this circumstance has not been sufficiently recognised, that the idea of Bacon's philosophy has generally speaking been but imperfectly apprehended.

(2.) Of the subjects which were to have occupied the remainder of the *Novum Organum* we learn something from a passage at the end of the second book.

"Nunc vero," it is said at the conclusion of the doctrine of prerogative instances, "ad adminicula et rectificationes inductionis, et deinceps ad concreta, et latentes processus, et latentes schematismos, et reliqua quæ aphorismo XXI ordine proposuimus, pergendum." On referring to the twenty-first aphorism we find a sort of table of contents of the whole work. "Dicemus itaque primo loco, de prærogativis instantiarum; secundo, de adminiculis inductionis; tertio, de rectificatione inductionis; quarto, de variatione inquisitionis pro naturâ subjecti; quinto, de prærogativis naturarum quatenus ad inquisitionem, sive de eo quod inquirendum est prius et posterius; sexto, de terminis inquisitionis, sive de synopsi omnium naturarum in universo; septimo, de deductione ad praxin, sive de eo quod est in ordine ad hominem; octavo, de parascevis ad inquisitionem; postremo autem, de scalâ ascensoriâ et descensoriâ axiomatum." Of these nine subjects the first is the only one with which we are at all accurately acquainted.

(3.) Bacon's method was essentially inductive. He rejected the use of syllogistic or deductive reasoning, except when practical applications were to be made of the conclusions, axiomata, to which the inquirer had been led by a systematic process of induction. "Logica quæ nunc habetur inutilis est ad inventionem scientiarum. . . . . Spes est una in inductione verâ."[1] It is to be observed that wherever Bacon speaks of an "ascending" process, he is to be understood to mean induction, of which it is the character to proceed from

[1] Nov. Org. i. 11. and 14.

that which is *nobis notius* to that which is *notius simpliciter*. Contrariwise when he speaks of a descent, he always refers to the correlative process of deduction. Thus when in the *Partis secundæ Delineatio* he says, . . . "meminerint homines in inquisitione activâ necesse esse rem per scalam descensoriam (cujus usum in contemplativâ sustulimus) confici: omnis enim operatio in individuis versatur quæ infimo loco sunt," — we are to understand that in Bacon's system deduction is only admissible in the inquisitio activa; that is, in practical applications of the results of induction. Similarly in the *Distributio Operis* he says, "Rejicimus syllogismum; neque id solùm quoad principia (ad quæ nec illi eam adhibent) sed etiam quoad propositiones medias." Everything was to be established by induction. "In constituendo autem axiomate forma inductionis alia quàm adhuc in usu fuit excogitanda est, eaque non ad principia tantùm (quæ vocant) probanda et invenienda, sed etiam ad axiomata minora, et media, denique omnia."[1]

(4.) It is necessary to determine the relation in which Bacon conceived his method to stand to ordinary induction. Both methods set out "a sensu et particularibus," and acquiesce "in maximè generalibus;"[2] but while ordinary induction proceeds "per enumerationem simplicem," by a mere enumeration of particular cases, "et precario concludit et periculo exponitur ab instantiâ contradictoriâ," the new method "naturam separare debet, per rejectiones et exclusiones debitas; et deinde post negativas tot quot sufficiunt super affirmativas concludere."[3] A form of induction was to be introduced, "quæ ex aliquibus generaliter concludat ita ut instantiam contradictoriam

[1] Nov. Org. i. 105. [2] Nov. Org. i. 22. [3] Nov. Org. i. 105.

inveniri non posse demonstretur."[1] In strong contrast with this method stands "the induction which the logicians speak of," which "is utterly vicious and incompetent." . . . "For to conclude upon an enumeration of particulars, without instance contradictory, is no conclusion, but a conjecture." . . . "And this form, to say truth, is so gross, as it had not been possible for wits so subtile as have managed these things to have offered it to the world, but that they trusted to their theories and dogmaticals, and were imperious and scornful towards particulars."[2] We thus see what is meant by the phrase "quot sufficiunt" in the passage which has been cited from the *Novum Organum;* it means "as many as may suffice in order to the attainment of certainty," it being necessary to have a method of induction, "quæ experientiam solvat et separet, et per exclusiones et rejectiones debitas necessario concludat."[3] Absolute certainty is therefore one of the distinguishing characters of the Baconian induction. Another is that it renders all men equally capable, or nearly so, of attaining to the truth. "Nostra verò inveniendi scientias ea est ratio ut non multum ingeniorum acumini et robori relinquatur; sed quæ ingenia et intellectus ferè exæquet;"[4] and this is illustrated by the difficulty of describing a circle liberâ manu, whereas every one can do it with a pair of compasses. "Omninò similis est nostra ratio." The cause to which this peculiarity is owing, is sufficiently indicated by the illustration: the

[1] Cogitata et Visa, § 18.

[2] Advancement of Learning. The corresponding passage in the De Augm. is in the 2nd chap. of the 5th book.

[3] Distrib. Operis, § 10.

[4] Nov. Org. i. 61., and comp. i. 122. Also the Inquisitio legitima de Motu, and Valerius Terminus, c. 19.

method "exæquat ingenia," "cùm omnia per certissimas regulas et demonstrationes transigat."

(5.) Absolute certainty, and a mechanical mode of procedure such that all men should be capable of employing it, are thus two great features of the Baconian method. His system can never be rightly understood if they are neglected, and any explanation of it which passes them over in silence leaves unexplained the principal difficulty which that system presents to us. But another difficulty takes the place of the one which is thus set aside. It becomes impossible to justify or to understand Bacon's assertion that his method was essentially new. "Nam nos," he says in the preface to the *Novum Organum*, "si profiteamur nos meliora afferre quam antiqui, eandem quam illi viam ingressi, nullâ verborum arte efficere possimus, quin inducatur quædam ingenii, vel excellentiæ, vel facultatis comparatio, sive contentio. . . . Verùm cùm per nos illud agatur, ut *alia omnino via* intellectui aperiatur illis intentata et incognita, commutata tota jam ratio est," &c. He elsewhere speaks of himself as being "in hâc re plane protopirus, et vestigia nullius sequutus."[1] Surely this language would be out of place, if the difference between him and those who had gone before him related merely to matters of detail; as, for instance, that his way of arranging the facts of observation was more convenient than theirs, and his way of applying an inductive process to them more systematic. And it need not be remarked that induction in itself was no novelty at all. The nature of the act of induction is as clearly stated by Aristotle as by any later writer. Bacon's design was surely much larger

[1] Nov. Org. i. 113.

than it would thus appear to have been. Whoever considers his writings without reference to their place in the history of philosophy will I think be convinced that he aimed at giving a wholly new method, — a method universally applicable, and in all cases infallible. By this method, all the knowledge which the human mind is capable of receiving might be attained, and attained without unnecessary labour. Men were no longer to wander from the truth in helpless uncertainty. The publication of this new doctrine was the *Temporis Partus Masculus;* it was as the rising of a new sun, before which "the borrowed beams of moon and stars" were to fade away and disappear.[1]

(6.) That the wide distinction which Bacon conceived to exist between his own method and any which had previously been known has often been but slightly noticed by those who have spoken of his philosophy, arises probably from a wish to recognise in the history of the scientific discoveries of the last two centuries the fulfilment of his hopes and prophecies. One of his early disciples however, who wrote before the scientific movement which commenced about Bacon's time had assumed a definite form and character — I mean Dr. Hooke — has explicitly adopted those portions of Bacon's doctrine which have seemingly been as a stumbling-block to his later followers. In Hooke's *General Scheme or Idea of the Present State of Natural Philosophy*,[2] which is in many respects the best commentary on Bacon, we find it asserted that in the pursuit of

[1] See, for instance, the *Præfatio Generalis*, where Bacon compares his method to the mariner's compass, until the discovery of which no wide sea could be crossed; an image probably connected with his favourite device of a ship passing through the pillars of Hercules, with the motto "Plus ultra."

[2] Published posthumously in 1705.

knowledge, the intellect "is continually to be assisted by some method or engine which shall be as a guide to regulate its actions, so as that it shall not be able to act amiss. Of this engine no man except the incomparable Verulam hath had any thoughts, and he indeed hath promoted it to a very good pitch." Something however still remained to be added to this engine or art of invention, to which Hooke gives the name of philosophical algebra. He goes on to say, "I cannot doubt but that if this art be well prosecuted and made use of, an ordinary capacity with industry will be able to do very much more than has yet been done, and to show that even physical and natural inquiries as well as mathematical and geometrical will be capable also of demonstration; so that henceforward the business of invention will not be so much the effect of acute wit, as of a serious and industrious prosecution."[1] Here the absolute novelty of Bacon's method, its demonstrative character, and its power of reducing all minds to nearly the same level, are distinctly recognised.

(7.) Before we examine the method of which Bacon proposed to make use, it is necessary to determine the nature of the problems to which it was, for the most part at least, to be applied. In other words, we must endeavour to determine the idea which he had formed of the nature of science.

Throughout his writings, science and power are spoken of as correlative — "in idem coincidunt;" and the reason of this is that Bacon always assumed that the knowledge of the cause would in almost all cases enable us to produce the observed effect. We shall see

[1] Present State of Nat. Phil. pp. 6, 7.

hereafter how this assumption connected itself with the whole spirit of his philosophy. I mention it now because it presents itself in the passage in which Bacon's idea of the nature of science is most distinctly stated. "Super datum corpus novam naturam, sive novas naturas, generare et superinducere, opus et intentio est humanæ potentiæ. Datæ autem naturæ formam, sive differentiam veram, sive naturam naturantem, sive fontem emanationis, (ista enim vocabula habemus quæ ad indicationem rei proxime accedunt) invenire, opus et intentio est humanæ scientiæ." This passage, with which the second book of the *Novum Organum* commences, requires to be considered in detail.

In the first place it is to be remarked, that natura signifies "abstract quality," — it is used by Bacon in antithesis with corpus or "concrete body." Thus the passage we have quoted amounts to this, that the scope and end of human power is to give new qualities to bodies, while the scope and end of human knowledge is to ascertain the formal cause of all the qualities of which bodies are possessed.

Throughout Bacon's philosophy, the necessity of making abstract qualities (naturæ) the principal object of our inquiries is frequently insisted on. He who studies the concrete and neglects the abstract cannot be called an interpreter of nature. Such was Bacon's judgment when, apparently at an early period of his life, he wrote the *Temporis Partus Masculus;*[1] and in the *Novum Organum* he has expressed an equivalent

[1] Mr. Ellis alludes, I think, to the *De Interpretatione Naturæ Sententiæ* XII., which M. Bouillet prints as part of the *Temporis Partus Masculus*. My reasons for differing with M. Bouillet on this point, and placing it by itself, and assigning it a later date, will be found in a note to Mr. Ellis's Preface to the *Novum Organum*. — *J. S.*

opinion: "quòd iste modus operandi, (qui naturas intuetur simplices licet in corpore concreto) procedat ex iis quæ in naturâ sunt constantia et æterna et catholica, et latas præbeat potentiæ humanæ vias."[1] Quite in accordance with this passage is a longer one in the *Advancement of Learning*, which I shall quote in extenso, as it is exceedingly important. "The forms of substances, I say, as they are now by compounding and transplanting multiplied, are so perplexed as they are not to be inquired; no more than it were either possible or to purpose to seek in gross the forms of those sounds which make words, which by composition and transposition of letters are infinite. But on the other side to inquire the form of those sounds or voices which make simple letters is easily comprehensible, and being known induceth and manifesteth the forms of all words which consist and are compounded of them. In the same manner, to inquire the form of a lion, of an oak, of gold — nay of water, of air — is a vain pursuit; but to inquire the forms of sense, of voluntary motion, of vegetation, of colours, of gravity and levity, of density, of tenuity, of heat, of cold, and all other natures and qualities which like an alphabet are not many, and of which the essences upheld by matter of all creatures do consist, — to inquire, I say, the true forms of these, is that part of metaphysique which we now define of." And a little farther on we are told that it is the prerogative of metaphysique to consider "the simple forms or difference of things" (that is to say, the forms of simple natures), "which are few in number, and the degrees and co-ordinations whereof make all this variety."

[1] Nov. Org. ii. 5.

We see from these passages why the study of simple natures is so important — namely because they are comparatively speaking few in number, and because, notwithstanding this, a knowledge of their essence would enable us, at least in theory, to solve every problem which the universe can present to us.

As an illustration of the doctrine of simple natures, we may take a passage which occurs in the *Silva Silvarum*. "Gold," it is there said, "has these natures: greatness of weight, closeness of parts, fixation, pliantness or softness, immunity from rust, colour or tincture of yellow. Therefore the sure way, though most about, to make gold, is to know the causes of the several natures before rehearsed, and the axioms concerning the same. For if a man can make a metal that hath all these properties, let men dispute whether it be gold or no." [1]

Of these simple natures Bacon has given a list in the third book of the *De Augmentis*. They are divided into two classes: schematisms of matter, and simple motions. To the former belong the abstract qualities, dense, rare, heavy, light, &c., of which thirty-nine are enumerated, the list being concluded with a remark that it need not be carried farther, "neque ultra rem extendimus." The simple motions — and it will be observed that the word "motion" is used in a wide and vague sense — are the motus antitypiæ, which secures the impenetrability of matter; the motus nexûs, commonly called the motus ex fugâ vacui, &c.; and of these motions fourteen are mentioned. This list however does not profess to be complete, and accordingly in the *Novum Organum* (ii. 48.) another list of sim-

[1] Compare Nov. Org. ii. 5.

ple motions is given, in which nineteen species are recognised.

The view of which we have now been speaking — namely, that it is possible to reduce all the phenomena of the universe to combinations of a limited number of simple elements — is the central point of Bacon's whole system. It serves, as we shall see, to explain the peculiarities of the method which he proposed.

(8.) In what sense did Bacon use the word "Form?" This is the next question which, in considering the account which he has given of the nature of science, it is necessary to examine. I am, for reasons which will be hereafter mentioned, much disposed to believe that the doctrine of Forms is in some sort an extraneous part of Bacon's system. His peculiar method may be stated independently of this doctrine, and he has himself so stated it in one of his earlier tracts, namely the *Valerius Terminus*. It is at any rate certain, that in using the word "Form" he did not intend to adopt the scholastic mode of employing it. He was much in the habit of giving to words already in use a new signification. "To me," he remarks in the *Advancement of Learning*, "it seemeth best to keep way with antiquity usque ad aras, and therefore to retain the ancient terms, though I sometimes alter the uses and definitions." And thus though he has spoken of the scholastic forms as figments of the human mind,[1] he was nevertheless willing to employ the word "Form" in a modified sense, "præsertim quum hoc vocabulum invaluerit, et familiariter occurrat."[2] He has however distinctly stated that in speaking of Forms, he is not to be understood to speak

[1] Nov. Org. i. 51. [2] Nov. Org. ii. 2.

of the Forms "quibus hominum contemplationes et cogitationes hactenus assueverunt."[1]

As Bacon uses the word in his own sense, we must endeavour to interpret the passages in which it occurs by means of what he has himself said of it; and this may I think be satisfactorily accomplished.

We may begin by remarking that in Bacon's system, as in those of many others, the relation of substance and attribute is virtually the same as the relation of cause and effect. The substance is conceived of as the causa immanens of its attributes,[2] or in other words it is the formal cause of the qualities which are referred to it. As there is a difference between the properties of different substances, there must be a corresponding difference between the substances themselves. But in the first state of the views of which we are speaking this latter difference is altogether unimaginable: "distincte quidem intelligi potest, sed non explicari imaginabiliter."[3] It belongs not to natural philosophy, but to metaphysics.

These views however admit of an essential modification. If we divide the qualities of bodies into two classes, and ascribe those of the former class to substance as its essential attributes, while we look on those of the latter as connected with substance by the relation of cause and effect — that is, if we recognise the distinction of primary and secondary qualities — the state of the question is changed. It now becomes possible to give a definite answer to the question, Wherein

[1] Nov. Org. ii. 17.

[2] See Zimmerman's Essay on the Monadology of Leibnitz, p. 86. (Vienna, 1807).

[3] Leibnitz De ipsâ Naturâ.

does the difference between different substances, corresponding to the difference between their sensible qualities, consist?

The answer to this question of course involves a reference to the qualities which have been recognised as primary; and we are thus led to the principle that in the sciences which relate to the secondary qualities of bodies the primary ones are to be regarded as the causes of the secondary.[1]

This division of the qualities of bodies into two classes is the point of transition from the metaphysical view from which we set out to that of ordinary physical science. And this transition Bacon had made, though not perhaps with a perfect consciousness of having done so. Thus he has repeatedly denied the truth of the scholastic doctrine that Forms are incognoscible because supra-sensible;[2] and the reason of this is clearly that his conception of the nature of Forms relates merely to the primary qualities of bodies. For instance, the Form of heat is a kind of local motion of the particles of which bodies are composed,[3] and that of whiteness a mode of arrangement among those particles.[4] This peculiar motion or arrangement corresponds to and engenders heat or whiteness, and this in every case in which those qualities exist. The statement of the distinguishing character of the motion or arrangement, or of whatever else may be the Form of a given phenomenon, takes the shape of a law; it is the law in fulfilling which any substance determines the existence of the quality in question. It is for this

[1] Whewell, Phil. Ind. Science, [book iv. ch. i.]
[2] See Scaliger, Exercit. in Cardan.
[3] [Nov. Org. ii. 20.]
[4] [Valerius Terminus, ii. 1.]

reason that Bacon sometimes calls the Form a law; he has done this particularly in a passage which will be mentioned a little farther on.

With the view which has now been stated, we shall I think be able to understand every passage in which Bacon speaks of Forms; — remembering however that as he has not traced a boundary line between primary and secondary qualities, we can only say in general terms that his doctrine of Forms is founded upon the theory that certain qualities of bodies are merely subjective and phenomenal, and are to be regarded as necessarily resulting from others which belong to substance as its essential attributes. In the passage from which we set out,[1] the Form is spoken of as vera differentia, the true or essential difference, — as natura naturans — and as the fons emanationis. The first of these expressions refers to the theory of definition by genus and difference. The difference is that which gives the thing defined its specific character. If it be founded on an accidental circumstance, the definition, though not incorrect if the accident be an inseparable one, will nevertheless not express the true and essential character of its subject; contrariwise, if it involve a statement of the formal cause of the thing defined.

The second of these phrases is now scarcely used, except in connexion with the philosophy of Spinoza. It had however been employed by some of the scholastic writers.[2] It is always antithetical to natura naturata, and in the passage before us serves not inaptly to ex-

[1] [Nov. Org. ii. 1.]

[2] See Vossius, De Vitiis Serm. in voce Naturare; and Castanæus, Distinctiones in voc. Natura.

press the relation in which the Form stands to the phenomenal nature which results from it.

The phrase fons emanationis does not seem to require any explanation. It belongs to the kind of philosophical language which attempts, more or less successfully, to give clearness of conception by means of metaphor. It is unnecessary to remark how much this is the case in the later development of scholasticism.

A little farther on in the second book of the *Novum Organum* than the passage we have been considering, — namely in the thirteenth aphorism, — Bacon asserts that the "forma rei" is "ipsissima res," and that the thing and its Form differ only as "apparens et existens, aut exterius et interius, aut in ordine ad hominem et in ordine ad universum." Here the subjective and phenomenal character of the qualities whose form is to be determined is distinctly and strongly indicated.

The principal passage in which the Form is spoken of as a law occurs in the second aphorism of the same book. It is there said that, although in nature nothing really exists (vere existat) except "corpora individua edentia actus puros individuos ex lege," yet that in doctrine this law is of fundamental importance, and that it and its clauses (paragraphi) are what he means when he speaks of Forms.

In denying the real existence of anything beside individual substances, Bacon opposes himself to the scholastic realism; in speaking of these substances as "edentia actus," he asserts the doctrine of the essential activity of substance; by adding the epithet "puros" he separates what Aristotle termed ἐντελέχειαι from mere motions or κινήσεις, thereby by implication denying the objective reality of the latter; and, lastly, by using the

word "individuos," he implies that though in contemplation and doctrine the form law of the substance (that is, the substantial form) is resoluble into the forms of the simple natures which belong to it, as into clauses, yet that this analysis is conceptual only, and not real.

It will be observed that the two modes in which Bacon speaks of the Form, namely as ipsissima res and as a law, differ only, though they cannot be reconciled, as two aspects of the same object.

Thus much of the character of the Baconian Form. That it is after all only a physical conception appears sufficiently from the examples already mentioned, and from the fact of its being made the most important part of the subject-matter of the natural sciences.

The investigation of the Forms of natures or abstract qualities is the principal object of the Baconian method of induction. It is true that Bacon, although he gives the first place to investigations of this nature, does not altogether omit to mention as a subordinate part of science, the study of concrete substances. The first aphorism of the second book of the *Novum Organum* sufficiently explains the relation in which, as he conceived, the abstract and the concrete, considered as objects of science, ought to stand to one another. This relation corresponds to that which in the *De Augmentis* [iii. 4.], he had sought to establish between Physique and Metaphysique, and which he has there expressed by saying that the latter was to be conversant with the formal and final causes, while the former was to be confined to the efficient cause and to the material. It may be asked, and the question is not easily answered, Of what use the study of concrete bodies was in Ba

con's system to be, seeing that the knowledge of the Forms of simple natures would, in effect, include all that can be known of the outward world? I believe that, if Bacon's recognition of physique as a distinct branch of science which was to be studied apart from metaphysique or the doctrine of Forms, can be explained except on historical grounds, — that is, except by saying that it was derived from the quadripartite division of causes given by Aristotle,[1] — the explanation is merely this, that he believed that the study of concrete bodies would at least at first be pursued more hopefully and more successfully than the abstract investigations to which he gave the first rank.[2]

However this may be, it seems certain that Bacon's method, as it is stated in the *Novum Organum*, is primarily applicable to the investigation of Forms, and that when other applications were made of it, it was to be modified in a manner which is nowhere distinctly explained. All in fact that we know of these modifications results from comparing two passages which have been already quoted;[3] namely the two lists in which Bacon enumerates the subjects to be treated of in the latter books of the *Novum Organum*.

It will be observed that in one of these lists the subject of concrete bodies corresponds to the "variation of the investigation according to the nature of the subject" in the other, and from this it seems to follow that Bacon looked on his method of investigating Forms as the fundamental type of the inductive process, from which in its other applications it deviated more or less

[1] For an explanation of which, see note on *De Augmentis*, iii. 4 [Complete Works]. — *J. S.*

[2] See, in illustration of this, *Nov. Org.* ii. 5.

[3] Vide supra, § 2.

according to the necessity of the case. This being understood, we may proceed to speak of the inductive method itself.

(9.) The practical criterium of a Form by means of which it is to be investigated and recognised, reduces itself to this, — that the form nature and the phenomenal nature (so to modify, for the sake of distinctness, Bacon's phraseology) must constantly be either both present or both absent; and moreover that when either increases or decreases, the other must do so too.[1] Setting aside the vagueness of the second condition, it is to be observed that there is nothing in this criterium to decide which of two concomitant natures is the Form of the other. It is true that in one place Bacon requires the form nature, beside being convertible with the given one, to be also a limitation of a more general nature. His words are "natura alia quæ sit cum naturâ datâ convertibilis et tamen sit limitatio naturæ notioris instar generis veri."[2] Of this the meaning will easily be apprehended if we refer to the case of heat, of which the form is said to be a kind of motion — motion being here the natura notior, the more general natura, of which heat is a specific limitation: for wherever heat is present there also is motion, but not vice versâ. Still the difficulty recurs, that there is nothing in the practical operation of Bacon's method which can serve to determine whether this subsidiary condition is fulfilled; nor is the condition itself altogether free from vagueness.

To each of the three points of that which I have called the practical criterium of the Form corresponds one of the three tables with which the investigation

[1] Nov. Org. ii. 4, 13, 16. [2] Nov. Org. ii. 4.

commences. The first is the table "essentiæ et præsentiæ," and contains all known instances in which the given nature is present. The second is the table of declination or absence in like case (declinationis sive absentiæ in proximo), and contains instances which respectively correspond to those of the first table, but in which, notwithstanding this correspondence, the given nature is absent. The third is the table of degrees or comparison (tabula graduum sive tabula comparativæ), in which the instances of the given nature are arranged according to the degree in which it is manifested in each.

It is easy to see the connexion between these tables, which are collectively called tables of appearance, "comparentiæ," and the criterium. For, let any instance in which the given nature is present (as the sun in the case of heat, or froth in the case of whiteness) be resolved into the natures by the aggregation of which our idea of it is constituted; one of these natures is necessarily the form nature, since this is always to be present when the given nature is. Similarly, the second table corresponds to the condition that the Form and the given nature are to be absent together, and the third to that of their increasing or decreasing together.

After the formation of these tables, how is the process of induction to be carried into effect? By a method of exclusion. This method is the essential point of the whole matter, and it will be well to show how much importance Bacon attached to it.

In the first place, wherever he speaks of ordinary induction and of his own method he always remarks that the former proceeds "per enumerationem sim-

plicem," that is, by a mere enumeration of particular cases, while the latter makes use of exclusions and rejections. This is the fundamental character of his method, and it is from this that the circumstances which distinguish it from ordinary induction necessarily follow. Moreover we are told that whatever may be the privileges of higher intelligences, man can only in one way advance to a knowledge of Forms: he is absolutely obliged to proceed at first by negatives, and then only can arrive at an affirmative when the process of exclusion has been completed (post omnimodam exclusionem).[1] The same doctrine is taught in the exposition of the fable of Cupid. For according to some of the mythographi Cupid comes forth from an egg whereon Night had brooded. Now Cupid is the type of the primal nature of things; and what is said of the egg hatched by Night refers, Bacon affirms, most aptly to the demonstrations whereby our knowledge of him is obtained; for knowledge obtained by exclusions and negatives results, so to speak, from darkness and from night. We see, I think, from this allegorical fancy, as clearly as from any single passage in his writings, how firmly fixed in his mind was the idea of the importance, or rather of the necessity, of using a method of exclusion.

It is not difficult, on Bacon's fundamental hypothesis, to perceive why this method is of paramount importance. For assuming that each instance in which the given nature is presented to us can be resolved into (and mentally replaced by) a congeries of elementary natures, and that this analysis is not merely subjective or logical, but deals, so to speak, with the very essence

[1] Nov. Org. ii. 15.

of its subject-matter, it follows that to determine the form nature among the aggregate of simple natures which we thus obtain, nothing more is requisite than the rejection of all foreign and unessential elements. We reject every nature which is not present in every affirmative instance, or which is present in any negative one, or which manifests itself in a greater degree when the given nature manifests itself in a less, or vice versâ. And this process when carried far enough will of necessity lead us to the truth; and meanwhile every step we take is known to be an approximation towards it. Ordinary induction is a tentative process, because we chase our quarry over an open country; here it is confined within definite limits, and these limits become as we advance continually narrower and narrower.

From the point of view at which we have now arrived, we perceive why Bacon ascribed to his method the characters by which, as we have seen, he conceived that it was distinguished from any which had previously been proposed. When the process of exclusion has been completely performed, only the form nature will remain; it will be, so to speak, the sole survivor of all the natures combined with which the given nature was at first presented to us. There can therefore be no doubt as to our result, nor any possibility of confounding the Form with any other of these natures. This is what Bacon expresses, when he says that the first part of the true inductive process is the exclusion of every nature which is not found in each instance where the given one is present, or is found where it is not present, or is found to increase where the given nature decreases, or vice versâ. And then, he goes

on to say, when this exclusion has been duly performed, there will in the second part of the process remain, as at the bottom, all mere opinions having been dissipated (abeuntibus in fumum opinionibus volatilibus), the affirmative Form, which will be solid and true and well defined.[1] The exclusion of error will necessarily lead to truth.

Again, this method of exclusion requires only an attentive consideration of each "instantia," in order first to analyse it into its simple natures, and secondly to see which of the latter are to be excluded — processes which require no higher faculties than ordinary acuteness and patient diligence. There is clearly no room in this mechanical procedure for the display of subtlety or of inventive genius.

Bacon's method therefore leads to certainty, and may be employed with nearly equal success by all men who are equally diligent.

In considering the only example which we have of its practical operation, namely the investigation of the form of heat,[2] it is well to remark a circumstance which tends to conceal its real nature. After the three tables of Comparentia, Bacon proceeds to the Exclusiva, and concludes by saying that the process of exclusion cannot at the outset (sub initiis) be perfectly performed. He therefore proposes to go on to provide additional assistance for the mind of man. These are manifestly to be subsidiary to the method of exclusions; they are to remove the obstacles which make the Exclusiva defective and inconclusive. But in the meanwhile, and as it were provisionally, the intellect may be permitted to attempt an affirmative determination on the subject

[1] Nov. Org. ii. 16. [2] Nov. Org. ii. 11—20.

before it: "Quod genus tentamenti Permissionem Intellectûs, sive Interpretationem inchoatam, sive Vindemiationem primam, appellare consuevimus." The phrase Permissio Intellectûs sufficiently indicates that in this process the mind is suffered to follow the course most natural to it; it is relieved from the restraints hitherto imposed on it, and reverts to its usual state. In this Vindemiatio we accordingly find no reference to the method of exclusion: it rests immediately on the three tables of Comparentia; and though of course it does not contradict the results of the Exclusiva, yet on the other hand it is not derived from them. If we lose sight of the real nature of this part of the investigation, which is merely introduced by the way "because truth is more easily extricated from error than from confusion," we also lose sight of the scope and purport of the whole method. All that Bacon proposes henceforth to do is to perfect the Exclusiva; the Vindemiatio prima, though it is the closing member of the example which Bacon makes use of, is not to be taken as the type of the final conclusion of any investigation which he would recognise as just and legitimate. It is only a parenthesis in the general method, whereas the Exclusiva, given in the eighteenth aphorism of the second book, is a type or paradigm of the process on which every true induction (inductio vera) must in all cases depend.

It may be well to remark that in this example of the process of exclusion, the table of degrees is not made use of.

Bacon, as we have seen, admits that the Exclusiva must at first be in some measure imperfect; for the Exclusiva, being the rejection of simple natures, cannot

be satisfactory unless our notions of these natures are just and accurate, whereas some of those which occur in his example of the process of rejection are ill-defined and vague.[1] In order to the completion of his method, it is necessary to remove this defect. A subsidiary method is required, of which the object is the formation of scientific conceptions. To this method also Bacon gives the name of induction; and it is remarkable that induction is mentioned for the first time in the *Novum Organum* in a passage which relates not to axioms but to conceptions.[2] Bacon's induction therefore is not a mere ἐπαγωγή, it is also a method of definition; but of the manner in which systematic induction is to be employed in the formation of conceptions we learn nothing from any part of his writings. And by this circumstance our knowledge of his method is rendered imperfect and unsatisfactory. We may perhaps be permitted to believe that so far as relates to the subject of which we are now speaking, Bacon never, even in idea, completed the method which he proposed. For of all parts of the process of scientific discovery, the formation of conceptions is the one with respect to which it is the most difficult to lay down general rules. The process of establishing axioms Bacon had succeeded, at least apparently, in reducing to the semblance of a mechanical operation; that of the formation of conceptions does not admit of any similar reduction. Yet these two processes are in Bacon's system of co-ordinate importance. All commonly received general scientific conceptions Bacon condemns as utterly worth-

[1] Nov. Org. ii. 19.; and compare i. 15., which shows the necessity of a complete reform.

[2] Nov. Org. i. 14., and comp. i. 18.

less.[1] A complete change is, therefore, required; yet of the way in which induction is to be employed in order to produce this change he has said nothing.

This omission is doubtless connected with the kind of realism which runs through Bacon's system, and which renders it practically useless. For that his method is impracticable cannot I think be denied, if we reflect not only that it never has produced any result, but also that the process by which scientific truths have been established cannot be so presented as even to appear to be in accordance with it. In all cases this process involves an element to which nothing corresponds in the tables of comparence and exclusion; namely the application to the facts of observation of a principle of arrangement, an idea, existing in the mind of the discoverer antecedently to the act of induction. It may be said that this idea is precisely one of the naturæ into which the facts of observation ought in Bacon's system to be analysed. And this is in one sense true; but it must be added that this analysis, if it be thought right so to call it, is of the essence of the discovery which results from it. To take for granted that it has already been effected is simply a petitio principii. In most cases the mere act of induction follows as a matter of course as soon as the appropriate idea has been introduced. If, for instance, we resolve Kepler's discovery that Mars moves in an ellipse into its constituent elements, we perceive that the whole difficulty is antecedent to the act of induction. It consists in bringing the idea of motion in an ellipse into connexion with the facts of observation; that is, in showing that an ellipse may be drawn through all the

[1] Nov. Org. i. 15, 16

observed places of the planet. The mere act of induction, the ἐπαγωγή, is perfectly obvious. If all the observed places lie on an ellipse of which the sun is the focus, then every position which the planet successively occupies does so too. This inference, which is so obvious that it must have passed through the mind of the discoverer almost unconsciously, is an instance of induction "per enumerationem simplicem;" of which kind of induction Bacon, as we have seen, has said that it is utterly vicious and incompetent.

The word realism may perhaps require some explanation. I mean by it the opinion, which Bacon undoubtedly entertained, that for the purposes of investigation, the objects of our thoughts may be regarded as an assemblage of abstract conceptions, so that these conceptions not only correspond to realities, which is of course necessary in order to their having any value, but may also be said adequately to represent them. In his view of the subject, ideas or conceptions (notiones) reside in some sort in the objects from which we derive them; and it is necessary, in order that the work of induction may be successfully accomplished, that the process by which they are derived should be carefully and systematically performed. But he had not perceived that which now at least can scarcely be doubted of, that the progress of science continually requires the formation of new conceptions whereby new principles of arrangement are introduced among the results which had previously been obtained, and that from the necessary imperfection of human knowledge our conceptions never, so to speak, exhaust the essence of the realities by which they are suggested. The notion of an alphabet of the universe, of which Bacon

has spoken more than once, must therefore be given up; it could at best be only an alphabet of the present state of knowledge. And similarly of the analysis into abstract natures on which the process of exclusion, as we have seen, depends. No such analysis can be used in the manner which Bacon prescribes to us; for every advance in knowledge presupposes the introduction of a new conception, by which the previously existing analysis is rendered incomplete, and therefore erroneous.

We have now, I think, succeeded in tracing the cause both of the peculiarities of Bacon's method, and of its practical inutility. Some additional information may be derived from an examination of the variations with which it is presented in different parts of his writings; — less however than if we could arrange his smaller works in chronological order. Nevertheless two results, not without their value, may be thus obtained; the one, that it appears probable that Bacon came gradually to see more of the difficulties which beset the practical application of his method; and the other, that the doctrine of Forms is in reality an extraneous part of his philosophy.

(10.) In the earliest work in which the new method of induction is proposed, namely, the English tract entitled *Valerius Terminus*, no mention is made of the necessity of correcting commonly received notions of simple natures. The inductive method is therefore presented in its simplest form, unembarrassed with that which constitutes its principal difficulty. But when we advance from *Valerius Terminus* to the *Partis secundæ Delineatio et Argumentum*, which is clearly of a later date, we find that Bacon has become aware of the necessity of having some scientific method for the

due construction of abstract conceptions. It is there said that the "pars informans," that is, the descriptions of the new method, will be divided into three parts — the ministration to the senses, the ministration to the memory, and the ministration to the reason. In the first of these, three things are to be taught; and of these three the first is how to construct and elicit from facts a duly formed abstract conception (bona notio); the second is how the senses may be assisted; and the third, how to form a satisfactory collection of facts. He then proposes to go on to the other two ministrations.

Thus the construction of conceptions would have formed the first part of the then designed *Novum Organum;* and it would seem that this arrangement was not followed when the *Novum Organum* was actually written, because in the meantime Bacon had seen that this part of the work involved greater difficulties than he had at first supposed. For the general division into "ministrationes" is preserved in the *Novum Organum*,[1] though it has there become less prominent than in the tract of which we have been speaking. In the ministration to the senses, as it is mentioned in the later work, nothing is expressly included but a good and sufficient natural and experimental historia; the theory of the formation of conceptions has altogether disappeared, and both this ministration and that to the memory are postponed to the last of the three, which contains the theory of the inductive process itself. We must set out, Bacon says, from the conclusion, and proceed in a retrograde order to the other parts of the subject. He now seems to have perceived that the theory of the formation of conceptions and that

[1] Nov. Org. ii. 10

of the establishment of axioms are so intertwined together, that the one cannot be presented independently of the other, although in practice his method absolutely requires these two processes to be carried on separately. His view now is, that at first axioms must be established by means of the commonly received conceptions, and that subsequently these conceptions must themselves be rectified by means of the ulterior aids to the mind, the fortiora auxilia in usum intellectûs, of which he has spoken in the nineteenth aphorism of the second book. But these fortiora auxilia were never given, so that the difficulty which Bacon had once proposed to overcome at the outset of his undertaking remained to the last unconquered. The doctrine of the *Novum Organum* (that we must first employ commonly received notions, and afterwards correct them) is expressly laid down in the *De Interpretatione Naturæ Sententiæ Duodecim*.[1] Of this however the date is uncertain.

It is clear that while any uncertainty remains as to the value of the conceptions (notiones) employed in the process of exclusion, the claim to absolute immunity from error which Bacon has made on behalf of his general method, must be more or less modified; and of this he seems to have been aware when he wrote the second book of the *Novum Organum*.[2]

(11.) Thus much of the theory of the formation of conceptions. With regard to the doctrine of Forms, it is in the first place to be observed that it is not mentioned as a part of Bacon's system, either in *Valerius Terminus* or in the *Partis secundæ Delineatio*, or in the *De Interpretatione Naturæ Sententiæ Duodecim*, although

[1] Vide § viii. of this tract

[2] Nov. Org. ii. 19

in the two last-named tracts the definition of science which is found at the outset of the second book of the *Novum Organum* is in substance repeated. This definition, as we have seen, makes the discovery of Forms the aim and end of science; but in both cases the word *form* is replaced by *causes*. It is however to be admitted that in the *Advancement of Learning*, published in 1605, Forms are spoken of as one of the subjects of Metaphysique. Their not being mentioned except ex obliquo in *Valerius Terminus* is more remarkable, because Bacon has there given a distinct name to the process which he afterwards called the discovery of the Form. He calls it the freeing of a direction, and remarks that it is not much other matter than that which in the received philosophies is termed the Form or formal cause. Forms are thus mentioned historically, but in the dogmatic statement of his own view they are not introduced at all.[1]

The essential character of Bacon's philosophy, namely the analysis of the concrete into the abstract, is nowhere more prominent than in *Valerius Terminus*. It is there said "that every particular that worketh any effect is a thing compounded more or less of diverse single natures, more manifest and more obscure, and that it appeareth not to whether (which) of the natures the effect is to be ascribed."[2] Of course the great problem is to decide this question, and the method of solving it is called "the freeing of a direction." In explanation of this name, it is to be observed that in *Valerius Terminus* the practical point

[1] I refer to my preface to *Valerius Terminus* for an illustration of some of the difficulties of this very obscure tract.

[2] Val. Ter. c. 17.

of view predominates. Every instance in which a given nature is produced is regarded as a *direction* for its artificial production. If air and water are mingled together, as in snow, foam, &c., whiteness is the result. This then is a direction for the production of whiteness, since we have only to mingle air and water together in order to produce it. But whiteness may be produced in other ways, and the direction is therefore not free. We proceed gradually to free it by rejecting, by means of other instances, the circumstances of this which are unessential: a process which is the exact counterpart of the Exclusiva of the *Novum Organum*. The instance I have given is Bacon's, who developes it at some length.

Here then we have Bacon's method treated entirely from a practical point of view. This circumstance is worthy of notice because it serves to explain why Bacon always assumes that the knowledge of Forms would greatly increase our command over nature, that it "would enfranchise the power of man unto the greatest possibility of works and effects." It has been asked what reason Bacon had for this assumption. "Whosoever knoweth any Form," he has said in the *Advancement*, "knoweth the utmost possibility of superinducing that nature upon any variety of nature." Beyond question, the problem of superinducing the nature is reduced to the problem of superinducing the Form; but what reason have we for supposing that the one is more easy of solution than the other? If we knew the Form of malleability, that is, the conditions which the intimate constitution of a body must fulfil in order that it may be malleable, does it follow that we could make glass so? So far as these questions

admit of an answer, *Valerius Terminus* appears to suggest it. Bacon connected the doctrine of Forms with practical operations, because this doctrine, so to speak, represented to him his original notion of the freeing of a direction, which, as the phrase itself implies, had altogether a practical significance.

Even in the *Novum Organum* the definition of the Form is made to correspond with the præceptum operandi, or practical direction.[1] The latter is to be "certum, liberum, et disponens sive in ordine ad actionem." Now a direction to produce the Form as a means of producing the given nature is certain, because the presence of the Form necessarily determines that of the nature. It is free, because it requires only that to be done which is necessary, since the nature can never be present unless its Form is so too. Thus far the agreement between the practical and the scientific view is satisfactory. But to the third property which the practical direction is to possess, namely its being in ordine ad actionem, or such as to facilitate the production of the proposed result, corresponds the condition that the Form is to be "the limitation of a more general nature;" that is to say, the Form presents itself as a limitation of something more general than the given nature, and as determining, not merely logically but also causatively, the existence of the latter. At this point the divergence between the practical and the scientific view becomes manifest; practical operations do not, generally speaking, present to us anything analogous to the limitation here spoken of, and there is no reason to suppose that it is easier to see how this limi-

[1] Nov. Org. ii. 4., which is the best comment on the dictum, Knowledge is power.

tation is to be introduced than to see how the original problem, the ἐξ ἀρχῆς προκείμενον, may be solved. But this divergence seems to show that the two views are in their origin heterogeneous; that the one contains the fundamental idea of Bacon's method, while the other represents the historical element of his philosophy. We shall however hereafter have occasion to suggest considerations which may seem to modify this conclusion.

(12.) In a survey of Bacon's method it is not necessary to say much of the doctrine of prerogative instances, though it occupies the greater part of the second book of the *Novum Organum*. It belongs to the unfinished part of that work; at least it is probable that its practical utility would have been explained when Bacon came to speak of the Adminicula Inductionis.

Twenty-seven kinds of instances are enumerated, which are said to excel ordinary instances either in their practical or their theoretical usefulness. To the word *instance* Bacon gives a wide range of signification. It corresponds more nearly to *observation* than to any other which is used in modern scientific language.

Of some classes of these instances collections are to be made for their own sake, and independently of any investigation into particular natures. Such, for instance, are the instantiæ conformes; Bacon's examples of which are mostly taken from comparative anatomy. One of them is the analogy between the fins of fishes, the feet of quadrupeds, and the feet and wings of birds; another, the analogy of the beak of birds and the teeth of other animals, &c.[1]

[1] Nov. Org. ii. 27. It does not seem that Bacon added much to what he found in Aristotle on the subject of these analogies.

The other classes of prerogative instances have especial reference to particular investigation, and are to be collected when individual tables of comparence are formed.

It would seem from this that the theory of prerogative instances is intended to guide us in the formation of these tables. But it is difficult to see how the circumstances which give any instance its prerogative could have been appreciated à priori. An instantia crucis,[1] to take the most celebrated of all, has its distinguishing character only in so far as it is viewed with reference to two contending hypotheses. In forming at the outset of an inquiry the appropriate tables, nothing would have led the interpreter to perceive its peculiar value.

This theory, whatever may be its practical utility, may supply us with new illustrations of the importance in Bacon's method of the process of exclusions.

At the head of the list — and placed there, we may presume, from the importance of the end which they promote — stand the instantiæ solitariæ, whose prerogative it is to accelerate the Exclusiva.[2] These are instances which exhibit the given nature in subjects which have nothing in common, except that nature itself, with the other subjects which present it to us. Thus the colours shown by the prism or by crystals are a solitary instance of colour, because they have nothing in common with the fixed colours of flowers, gems, &c. Whatever therefore is not independent of the particular constitution of these bodies must be excluded from the form of colour.

Next to the instantiæ solitariæ are placed the instan

[1] Nov. Org. ii. 36. [2] Nov. Org. ii. 22.

tiæ migrantes, which show the given nature in the act of appearing or of disappearing; as when glass, being pounded, becomes white. Of these it is said that they not only accelerate and strengthen the Exclusiva, but also confine within narrow limits the Affirmative, or Form itself, by showing that it is something which is given or taken away by the observed change. A little farther on Bacon notices the danger in these cases of confounding the efficient cause with the Form, and concludes by saying "But this is easily remedied by a legitimately performed Exclusiva."

Other remarks to the same effect might be made with reference to other classes of instances; but these are probably sufficient.

I shall now endeavour to give an account of Bacon's views on some questions of philosophy, which are not immediately connected with the reforms he proposed to introduce.

(13.) It has sometimes, I believe, been supposed that Bacon had adopted the atomic theory of Democritus. This however is by no means true; but certainly he often speaks much more favourably of the systems of the earlier physicists, and especially of that of Democritus, than of the philosophy of Plato and Aristotle. In doing this he may, perhaps, have been more or less influenced by a wish to find in antiquity something with which the doctrines he condemned might be contrasted. But setting this aside, it is certain that these systems were more akin to his own views than the doctrine of the schools of which Socrates may be called the founder. The problems which they proposed were essentially physical, — given certain material first prin-

ciples, to determine the origin and causes of all phenomena. They were concerned, for the most part, with that which is accessible to the senses, or which would be so if the senses were sufficiently acute. In this they altogether agree with Bacon, who, though he often speaks of the errors and shortcomings of the senses, yet had never been led to consider the question which stands at the entrance of metaphysical philosophy, namely whether the subjective character of sensation does not necessarily lead to scepticism, if no higher grounds of truth can be discovered. The scepticism of Protagoras, and Plato's refutation of it, seemed to him to be both but idle subtleties. Plato, Aristotle, and their followers, were in his opinion but a better kind of sophists. What Dionysius said to Plato, that his discourse was but dotage, might fitly be applied to them all.[1]

It cannot be denied, that to Bacon all sound philosophy seemed to be included in what we now call the natural sciences; and with this view he was naturally led to prefer the atomic doctrine of Democritus to any metaphysical speculation. Every atomic theory is an attempt to explain some of the phenomena of matter by means of others; to explain secondary qualities by means of the primary. And this was what Bacon himself proposed to do in investigating the Forms of simple natures. Nevertheless he did not adopt the peculiar opinions of Democritus and his followers. In the *Novum Organum* he rejects altogether the notion of a vacuum and that of the unchangeableness of matter.[2] His theory of the intimate constitution of bodies does

[1] Redargut. Phil. et Nov. Org. i. 71.
[2] Nov. Org. ii. 8. Compare Cogit. De Nat. Rerum.

not, he remarks, relate to atoms properly so called, but only to the actually existing ultimate particles. Bacon cannot therefore be said to be a follower of Democritus, though he has spoken of him as being, of all the Greek philosophers, the one who had the deepest insight into nature.[1]

But though Bacon was not an atomist, he was what has been called a mechanical physiologist. Leibnitz's remark that the restorers of philosophy[2] all held the principle that the properties of bodies are to be explained by means of magnitude, figure, and motion (a statement which envelopes every such theory of matter as that of Descartes, together with the old atomic doctrine), is certainly true of Bacon.

(14.) The opinion which Bacon had formed as to the class of subjects which ought to be included in Summary Philosophy (the English phrase by which he renders the expression he sometimes uses, namely prima philosophia), is worthy of attention.

In the writings of Aristotle, the first philosophy denotes the science which since his time has been called metaphysics. It is the science of first principles, or as he has himself defined it, the science of that which is, as such. In the first book of the *Metaphysics* we find a proof of the necessity of having such a science, distinct from and in a manner superior to all others.

Bacon, adopting Aristotle's name, applied it differently. With him, the first philosophy is divided into two parts. Of these the first is to be a receptacle of

[1] Nov. Org. i. 51.; also Parm. Teles. and Dem. Phil.

[2] Namely, the Cartesians, Verulam, Hobbes, &c. See his letter to Thomasius, p. 48. of the edition of his philosophical works by Erdmann.

the axioms which do not belong exclusively to particular sciences, but are common to more than one; while the second is to inquire into the external or adventitious conditions of existences — such as the much and the little, the like and the unlike, the possible and impossible, &c.

In illustration of the contents of the first part, Bacon quotes several axioms which are applicable in more than one science. Of these the first is, "If to unequals are added equals, the sums are unequal," which is a mathematical principle, but which, Bacon says, referring to the distinction laid down by Aristotle between commutative and distributive justice, obtains also in moral science; inasmuch as it is the rule by which distributive justice must be guided. The next is, "Things which agree with a third, agree with one another," — which is also a mathematical principle, but yet, differently stated, forms the foundation of the theory of syllogism. Thus far Bacon's doctrine does not materially dissent from Aristotle's, who has taught the necessity of recognising in all sciences two kinds of principles, those which are proper to the subject of each science, and those which, connecting themselves with the doctrine of the categories, are common to all. The last are in his nomenclature axioms, though Bacon, following probably Ramus, who in his turn followed Cicero and the Stoics, gives a much more general sense to this word; and it is to be remarked that Aristotle has given as an instance of an axiom the first of the two which I have quoted from Bacon, or at any rate another which is in effect equivalent to it. But most of the instances which Bacon goes on to give are of a different na-

ture. They are not derived from the laws of thought, but on the contrary involve an empirical element, and therefore are neither self evident, nor capable of an à priori proof. Thus the axiom that "a discord resolved into a concord improves the harmony," is, Bacon says, not only true in music, but also in ethics and the doctrine of the affections. But this axiom is in its literal sense merely a result of observation, and its application to moral subjects is clearly only analogical or tropical. Again, that "the organs of the senses are analogous to instruments which produce reflection," is, Bacon says, true in perspective, and also in acoustics; being true both of the eye and ear. Here we have a result of observation which is made to enter into two different sciences simply in virtue of the classification employed. For this axiom, if true, properly belongs to physiology, and neither to perspective nor to acoustics; though in a secondary and derivative manner a portion of the truth it includes may be introduced into these sciences. And so on. There is however one of these axioms which is of higher authority: "Quantum naturæ nec minuitur nec augetur:" which, Bacon says, is true not only in physics, but also in natural theology, if it be stated in a modified form; viz. if it be said that it belongs to Omnipotence to make something out of nothing, or vice versâ. Of this axiom it may be remarked, that it is common to physics and natural theology simply because the subjects of these sciences are, in some measure, common to both; wherein it differs from the Aristotelian conception of an axiom. But it is of more interest to observe, that this axiom of which the truth is derived from our notion of substance, and which can never be established by an

empirical demonstration, is constantly quoted by Bacon as a principle of incontestable truth ; of which his theory of specific gravities is in some sort only an application.

The question arises both with regard to this axiom and to the others, In what manner Bacon supposed that they ought to be demonstrated ; or, if he thought they required no demonstration, in what manner he conceived that the mind apprehended their truth? He has certainly affirmed in express terms that there can be only two ways of arriving at truth, namely syllogism and induction ; both of which are manifestly inapplicable to some at least of the principles which he includes in the philosophia prima. But whether he would have admitted that this dictum admits of exception in relation to these cases, or on the other hand had not been led to consider the nature of the difficulty which they present, we have, I think, no means of deciding. It is to be observed that the philosophia prima is spoken of as a collection (receptaculum) of axioms — a phrase which implies that it is not a science in itself, having its own principles and an independent development, but that, contrariwise, it derives from the contributions of other sciences the elements of which it is composed. Of the second part we are unable to speak more definitely than of the first. It is obviously a reflexion of the Aristotelian doctrine of the categories,[1] from which, however, Bacon intended to contrast it by requiring that the "conditiones entium," which he has doubtless called transcendent from their applicability to all classes of

[1] Trendelenberg has accordingly quoted the passages in the *De Augmentis* which relate to it, in the historical part of his work on the categories.

objects, should be treated not logically but physically.[1]

But then what are the questions to be resolved in this mode of treating them? Bacon gives some examples of the discussions which ought to occupy this part of philosophy. The first is, why there is so much of one kind of substance, and so little of another — why, for instance, so much more iron in the world than gold, &c. This belongs to the inquiry "de multo et parvo." Again, in treating "de simili et diverso," it ought to be explained why between dissimilar species are almost always interposed others which partake of the nature of both, and form, as it were, ambiguous species — for instance, bats between birds and quadrupeds, or moss between corruption and plants, &c. The difficulty however which I have already mentioned in speaking of the other part of the philosophia prima recurs with reference to this, namely by what method were the questions here proposed to be answered? If by induction, by induction on what data? and if not, by what other way of arriving at truth?

The illustrations which Bacon has given, and perhaps his way of looking at the whole subject, connect themselves with what has recently been called palætiology. The questions which Bacon proposes are questions as to how that which actually exists, and which in the present order of things will continue to exist, came into being — whether abruptly or by slow transitions, and under what agency. He seems to point, though from a distance, to discussions as to the formation of strata and the succession of species.

[1] De Augmentis iii. 4.

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Yet on the other hand the discussion on Like and Unlike was to include at least one portion of a different character, namely why, in despite of the maxim "similia similibus gaudent," iron does not attract iron but the magnet, nor gold gold, but quicksilver.

(15.) Another subject, sufficiently interesting to be here mentioned, though less connected with Bacon's general views, is the doctrine which he entertained touching the nature of the soul. He distinguishes in several parts of his writings between the animal soul, common, at least in kind, to man and to the brutes, and the immortal principle infused by the divine favour into man only.[1] To the latter he gave the name of spiraculum, which was of course suggested by the text, "Spiravit in faciem ejus spiraculum vitæ." M. Bouillet, in his edition of Bacon's philosophical works,[2] condemns this doctrine of man's having two souls, and goes on to remark that Bacon was led to adopt it in deference to the opinions of the schoolmen, and that it is also sanctioned by S. Augustine. In these remarks he is much less accurate than usual; the truth being that the doctrine of the duality of the soul is condemned very strongly by S. Augustine and by the schoolmen, and that there is no doubt as to the source from which Bacon derived it, namely from the writings of Telesius. The notion of a lower soul, distinct in essence from the higher principle of man's nature, is in reality much older than Telesius. We find it for instance among the Manichees — a circumstance which makes it singular that S. Augustine should have been supposed to countenance it. Both in his work *De*

[1] De Augmentis iv. 3.

[2] Œuvres Philosophiques de Bacon. Paris 1834. — *J. S.*

Ecclesiæ Dogmatibus, and nearly in the same words in that *De Animâ*, he rejects in the most precise and accurate manner the doctrine of two distinct souls, affirming that there is but one, which is at once the principle of nutrition, of sensation, and of reason. In opposing the tenets of the Manichæans, he has more than once condemned the same doctrine, though less at length than in the works just mentioned. The school men also peremptorily rejected the doctrine which M. Bouillet has affirmed that Bacon derived from them. Thus S. Thomas Aquinas says, "Impossibile est in uno homine esse plures animas per essentiam differentes, sed una tantum est anima intellectiva quæ vegetativæ et sensitivæ et intellectivæ officiis fungitur."[1] And this follows at once from the received opinion, that the soul is joined to the body as its form (ut forma unitur corpori). It would be easy to multiply citations to the same effect; but as no schoolman could venture to contradict an emphatically expressed opinion of S. Augustine, it appears unnecessary to do so.[2]

Telesius of Cozensa, whom Bacon has commended as "the best of the novellists," was one of the Italian reformers of philosophy. Tennemann's remark that the reform which he attempted to introduce was but

[1] S. Thom. Prim. Q. 76. a. 3. Concl.

[2] With what bold ignorance the schoolmen are sometimes spoken of is well seen in Dr. Gutwauer's preface to his edition of Leibnitz *De Principio Individui*. The sixth proposition in the *Corollarium* attached to this disputation is as follows:—"Hominis solum una est anima quæ vegetativam et sensitivam virtualiter includat." The learned Doctor declares that in this statement Leibnitz set himself in direct opposition to the schoolmen, and that it contains the germ of Leibnitz's own psychology; the statement being almost a literal transcript of that of St. Thomas Aquinas. Sum. i. Q. 76. a. 3., to which I have already referred. Leibnitz scarcely thought that in following the Angelic Doctor, he was protesting against scholasticism.

partial, as having reference only to the natural sciences, is not altogether accurate, but it describes with sufficient correctness the general character of his writings. They contain an attempt to explain all phenomena, including those of animal life, on the hypothesis of the continuous conflict and reciprocal action of two formal principles, heat and cold. His other doctrines are either subordinated to this kind of dualism, or are merely the necessary complements of a system of philosophy. In proposing to inquire into the nature and origin of the soul, he had no other end in view than to arrive at an explanation of the phenomena of sensation, voluntary motion, &c., which should be in accordance with his fundamental hypothesis. He therefore sets out from the physiological point of view; and in order to explain the phenomena of animal and vegetable life, refers them to an indwelling spiritus, or animal soul, which in plants resides in the bark and fibres, and in animals in the white and exsanguine parts of the body, the bones being however excepted.[1] The animal and vegetable souls are in essence alike, but the latter is "paulo quam qui in animalibus inest crassior." In both cases the origin of this anima is the same; it is educed from the seed (educta ex semine), and is to all intents as truly material as any other part of the body.

In the application of these views to the soul of man, Telesius was met by considerations of another order. The soul educed ex semine, was (like the body which it animated, and of which it was only the subtlest portion) propagated by generation; whereas it was decided by orthodox theology that souls are not ex traduce, de

[1] De Rerum Nat. v. 1. et vi. 26.

not pass from parent to child in the way Telesius must have supposed. The soul is a gift, which after death is to return to Him who gave it. I do not conceive that Telesius's attempt to co-ordinate this doctrine with his own views arose merely from a wish to avoid the imputation of heresy. His writings are, I think, free from that tone of mocking deference to authority by which those of many of his contemporaries are disfigured. They have, on the contrary, much of the melancholy earnestness which characterises those of his disciple Campanella. The difference between the faculties of men and brutes appeared to him to be such that merely a subtler organisation of the spiritus would be insufficient to account for it. Man's higher faculties are to be ascribed to a higher principle, and this can only be conceived of as a divinely formed soul. The question as to the relation between the two souls may be presented under two aspects, namely what are the faculties in man which ought to be ascribed to each of them? and again are these two souls wholly independent, and if not, how are they connected? The criterion by which Telesius would decide what ought to be reserved as the peculiar appanage of the divinely created soul, appears to be this — that which in man is analogous to the faculties we recognise in brutes ought to be ascribed to the principle by which they are animated and which we possess in common with them. Whatever, on the contrary, seems peculiar to man, more especially the sense of right and wrong, which is the foundation of all morality, ought to be ascribed to the principle which it is our prerogative to possess.[1]

As to the connexion between the two, Telesius

[1] De Rerum Naturâ, v. 2.

decides "both on grounds of human reason and from the authority of Scripture" that they cannot be wholly independent of each other, and he accordingly affirms that the divinely created soul is the Form of the whole body, and especially of the spiritus itself. That the soul is the Form of the body he could not without heresy deny,[1] although he condemns Aristotle for saying so; asserting that Aristotle refers to the spiritus, and not to the true soul, with which probably he was unacquainted.[2] The tendency of these views is towards materialism; the immaterial principle being annexed to the system, as it were, ab extra. Accordingly Telesius's disciple Donius, whom Bacon has more than once referred to, omits it altogether.[3]

Comparing the views of Telesius with those of Bacon, we see that in both the duality of the soul is distinctly asserted, and that in both the animal soul is merely material.[4] Our knowledge of the divinely derived principle must rest principally on revelation. Let this knowledge be drawn, he counsels us, from the same fountain of inspiration from whence the substance of the soul itself proceeded.

Bacon rejects or at least omits Telesius's formula, that this higher soul is the Form of the body — a formula to which either in his system or that of Telesius no definite sense could be attached. He differs from

[1] The collection known as the Clementines contains an authoritative decision on this point. "Ut quisque deinceps asserere defendere aut tenere pertinaciter præsumpserit, quod anima rationalis non sit forma corporis humani per se et essentialiter tanquam hæreticus sit censendus." I quote from Vulpes on Duns Scotus, Disp. 46. a. 5. To this decision Telesius seems to allude, De Rer. Nat. v. 40. Campanella has expressly mentioned it.

[2] De Rer. Nat. v. 3.

[3] See his De Nat. Hominis.

[4] Proceeding e matricibus elementorum, De Augm. iv. 3.

his predecessor in this also, that with him the spiritus is more a physiological and less a psychological hypothesis than with Telesius — it is at least less enwrapped in a psychological system than we find it in the *De Rerum Naturâ*.

On the other hand, he has not, I think, recognised so distinctly as Telesius or Campanella the principle that to the rational soul alone is to be referred the idea of moral responsibility; and the fine passage on the contrast of public and private good in the seventh book of the *De Augmentis* seems to show (if Bacon meant that the analogy on which it is based should be accepted as anything more than an illustration) that he conceived that something akin to the distinction of right and wrong is to be traced in the workings, conscious or unconscious, of all nature.

(16.) We are here led to mention another subject, on which again the views of Telesius appear to have influenced those of Bacon. That all bodies are animated, that a principle of life pervades the whole universe, and that each portion, beside its participation in the life of the world, has also its proper vital principle, are doctrines to which in the time of Bacon the majority of philosophical reformers were at least strongly inclined. The most celebrated work in which they are set forth is perhaps the *De Sensu Rerum* of Campanella. The share which it had in producing the misfortunes of his life is well known, and need not here be noticed.

In one of his letters to Thomasius,[1] Leibnitz points out how easy the transition is from the language which the schoolmen held touching substantial forms and the workings of nature to that of Campanella: "Ita reditur

[1] P. 18. of Erdmann's edition of his philosophical works.

ad tot deunculos quot formas substantiales et Gentilem prope polytheismum. Et certe omnes qui de substantiis illis incorporalibus corporum loquuntur non possunt mentem suam explicare nisi translatione a Mentibus sumptâ. Hinc enim attributus illis appetitus vel instinctus ille naturalis ex quo et sequitur cognitio naturalis, hinc illud axioma: Natura nihil facit frustra, omnis res fugit sui destructionem, similia similibus gaudent, materia appetit formam nobiliorem, et alia id genus. Quum tamen reverâ in naturâ nulla sit sapientia, nullus appetitus, ordo vero pulcher ex eo oriatur, quia est horologium Dei." To the censure implied in these remarks Aristotle is himself in some measure liable, seeing that he ascribed the various changes which go on around us to the half-conscious or unconscious workings of an indwelling power which pervades all things, and to which he gives the name of Nature. Nature does nothing in vain and of things possible realises the best, but she does not act with conscious prevision. She is, so to speak, the instinct of the universe.

It is on account of these views that Bacon charges Aristotle with having set aside the doctrine of a providence, by putting Nature in the place of God.[1] Nevertheless Bacon himself thought it possible to explain large classes of phenomena by referring them, not certainly to the workings of Nature, but to the instincts and appetites of individual bodies. His whole doctrine of simple motions is full of expressions which it is very difficult to understand without supposing that Bacon had for the time adopted the notion of universally diffused sensation. Thus the "motus nexûs" is that in

[1] De Aug. iii. 4.

virtue of which bodies, as delighting in mutual contact, will not suffer themselves to be separated. All bodies, we are told, abhor a solution of continuity, and the rising of cream is to be explained by the desire of homogeneous elements for one another.

The distinction which Bacon has elsewhere taken between sensation and perception, which corresponds to Leibnitz's distinction between apperception and perception, does not appear to accord with these expressions. He there asserts that inanimate bodies have perception without sensation. But such words as *desire* and *horror* imply not only a change worked in the body to which they are applied in virtue of the presence of another, but also a sense of that presence, — that is, in Bacon's language, not only perception but sensation.

The contrast between the expressions I have quoted and those of which he made use in other parts of his writings, is remarkable. In stating the doctrine of simple motions, he speaks as if all phenomena were to be explained by means of the desires and instincts of matter, every portion of which is more or less consciously sentient. But in other passages we find what at first appears to be a wholly different view, namely that phenomena are to be explained by the site, form, and configuration of atoms or ultimate particles, capable neither of desire nor fear, and in all their motions simply fulfilling the primary law impressed on them by Providence.

Nevertheless there is here no real inconsistency. For Bacon, following Telesius, ascribed all the phenomena of animal life to the spiritus, which, though it is the subtlest portion of the body which it animates, is notwithstanding as truly material as any other part. In

every body, whether animated or not, dwells a portion of spirit, and it was natural therefore to ascribe to it some share of the powers which the more finely constituted spirits of animals were supposed to possess. How far however this analogy between animate and inanimate bodies ought to be carried, was a doubtful question; and we need not be surprised to find that Bacon sometimes denies and sometimes appears to admit that the latter as well as the former are, to a certain extent at least, consciously sentient. But in all cases he proposed to explain the phenomena of animal life by means of the ultimate constitution of matter. Thus such phenomena as the rising of cream, the subsidence of the lees of wine, the clinging of gold leaf round the finger, &c., were to be explained in the first instance by the instincts and appetites of portions of matter, and afterwards to receive a deeper and more fundamental explanation when these instincts and appetites were themselves shown to result from the site, form, and configuration of the ultimate particles of which all bodies are composed.

To the doctrine of universally diffused sensation, so far as he adopted it, Bacon was led by the writings of many of his contemporaries, and in particular by those of Telesius. Brucker has remarked, and with perfect truth, that this doctrine is stated as distinctly, though not so conspicuously, by Telesius as by Campanella. Added to which this doctrine serves to explain phenomena of which, without it, no explanation could readily be given. Thus Bacon is much disposed to ridicule Gilbert for the pains he had bestowed on the subject of electrical attraction, affirming that it is merely the result of the power which friction possesses to excite

the appetite of bodies for contact. This appetite "aerem non bene tolerat, sed aliud tangibile mavult."

(17.) Bacon's opinion as to Final Causes has often been discussed. It seems however scarcely necessary to refute the interpretation which on no just grounds has been given to the phrase, "causarum finalium inquisitio tanquam virgo Deo consecrata nihil parit."[1] Nihil parit, as the context plainly shows, [means simply *non parit opera*].[2] Bacon is speaking of the classification of physics and metaphysics — the one being the science of the material and efficient cause, and the other containing two parts, namely the doctrine of forms and the doctrine of final causes. To physics corresponds in practical application mechanica or mechanics — to metaphysics, magia or natural magic. But magia corresponds to metaphysique because the latter contains the doctrine of Forms; that of final causes admitting from its nature of no practical application. It is this idea which Bacon has expressed by saying that the doctrine in question is, as it were, a consecrated virgin.

It is not sufficiently remarked that final causes have often been spoken of without any reference to a benevolent intention. When it is said that the final cause of a stone's falling is "locus deorsum," the remark is at least but remotely connected with the doctrine of an intelligent providence. We are to remember that Bacon has expressly censured Aristotle for having made use of final causes without referring to the fountain

[1] De Augm. iii. 5. See note on the place. — *J. S.*

[2] I have supplied these words to complete the sentence, which ends abruptly at the bottom of a page, a fresh page having apparently been substituted for that which originally followed. — *J. S.*

from which they flow, namely the providence of the Creator. And in this censure he has found many to concur.

Again, in any case in which the benevolent intention can be perceived, we are at liberty to ask by what means and according to what laws this benevolent intention is manifested and made efficient. If this question is not to be asked, there is in the first place an end of physical science, so far as relates to every case in which a benevolent intention has been or can be recognised; and in the second, the argument à posteriori founded on the contrivance displayed in the works of creation is entirely taken away.

This is, in effect, what Bacon says in the passage of the *De Augmentis* in which he complains of the abuse of final causes. If, he affirms, the physical cause of any phenomenon can be assigned as well as the final, so far is this from derogating from our idea of the divine wisdom, that on the contrary it does but confirm and exalt it. "Dei sapientia effulget mirabilius cum natura aliud agit, providentia aliud elicit, quam si singulis schematibus et motibus naturalibus providentiæ characteres essent impressi."[1] And a little farther on he expresses an opinion which we shall do well always to remember, namely that so far is the study of physical causes from withdrawing men from God and providence, that on the contrary those who have occupied themselves in searching them out have never been able to find the end of the matter without having recourse at length to the doctrine of divine providence.

In one respect Bacon seems to have overlooked the advantage which is to be derived from the study of

[1] De Aug. iii. 4.

final causes. In the sciences which relate to animal and vegetable life, the conviction that every part of the organisation has its appropriate function which conduces to the well-being of the whole, serves not only to direct our thoughts to the wisdom of the Creator, but also to guide our investigation into the nature of the organisation itself.

(18.) It will now, I think, be well to attempt to arrange the fundamental ideas of Bacon's system in the order in which, as we may conceive, they presented themselves to his mind. To do this will necessarily involve some degree of repetition; but it will enable us to form a better idea of the scope and spirit of his philosophy.

When, at the outset of his philosophical life, he looked round on the visible universe, it would seem that to him the starry heavens, notwithstanding the grandeur of the spectacle they present to us, were of less interest than things on earth. The stars in their courses declare the glory of God; but, excepting the great lights which rule the day and night, they exert no conspicuous influence on the welfare of mankind. And on the other hand it is certain that we can in no-wise affect the causes by which these phenomena are produced. But on the earth beneath, and in the waters under the earth, Nature is perpetually working in ways which it is conceivable that we may be able to imitate, and in which the beneficence of the Creator, wherein His glory is to us chiefly visible, is everywhere to be traced. Wherever we turn, we see the same spectacle of unceasing and benevolent activity. From the seed of corn Nature developes the stalk, the blade,

and the ear, and superinduces on the yet immature produce the qualities which make it fit for the sustenance of man. And so, too, animal life is developed from its first rudiments to all the perfection which it is capable of attaining. And though this perfection is necessarily transitory, yet Nature, though she cannot perpetuate the individual, yet continues the species by unceasing reproduction.

But the contemplation of God's works, glorious as they are, is not the whole of man's business here on earth. For in losing his first estate he lost the dominion over the creatures which was its highest privilege, and ever since has worn out few and evil days, exposed to want, sickness, and death. His works have all been vanity and vexation of spirit, his labour nearly profitless, his knowledge for the most part useless. Is his condition altogether hopeless, or may it not be possible to soften, though not to set aside, the effects of the primal curse? To this question Bacon unhesitatingly made answer, that of His great mercy God would bless our humble endeavours to restore to suffering humanity some part at least of what it had lost; and thus he has more than once described the instauration of the sciences as an attempt to regain, so far as may be, that of which the Fall deprived us.

A deep sense of the misery of mankind is visible throughout his writings. The principal speaker in the *Redargutio Philosophiarum*, and the son [father] of Solomon's House in the *New Atlantis*, both express Bacon's idea of what the philosopher ought to be; and of both it is said that their countenance was as the countenance of one who pities men. Herein we see the reason why Bacon has often been called an utili-

rarian; not because he loved truth less than others, but because he loved men more.

The philosopher is therefore not merely to contemplate the works of the Creator, but also to employ the knowledge thus obtained for the relief of man's estate. If we ask how this is to be done, we find, Bacon tells us (and here he still seems to recur to the idea that the new philosophy is to be in some sort a restoration to man of his original condition), that as no one can enter into the kingdom of heaven "nisi sub personâ infantis," so, too, in order to obtain a real and fruitful insight into Nature, it is necessary to become as a little child, to abnegate received dogmas and the idols by which the mind is most easily beset, and then to follow with childlike singleness of purpose the indications which Nature gives us as to how her operations are performed. For we can command Nature only by obeying her; nor can Art avail anything except as Nature's handmaiden. We can affect the conditions under which Nature works; but things artificial as well as things natural are in reality produced not by Art but Nature. Our power is merely based upon our knowledge of the procedure which Nature follows. She is never really thwarted or controlled by our operations, though she may be induced to depart from her usual course, and under new and artificial conditions to produce new phenomena and new substances.

Natural philosophy, considered from this point of view, is therefore only an answer to the question, How does Nature work in the production of phenomena? When, to take a trivial instance, she superinduces yellowness on the green leaf, or silently and gradually transforms ice into crystal, we ask how are these

changes brought about? — what conditions are necessary and sufficient in order that the phenomena we observe may be engendered? If we knew what these conditions are, we might ourselves be able to determine their existence, and then the corresponding phenomena would necessarily follow, since the course of Nature is absolutely uniform.

At this point of the development of Bacon's system, the question of method would naturally present itself to him. Having determined what the object of our inquiries is to be, we must endeavour to find a way of attaining it.

For this end Bacon, as we have seen, proposes to examine all the cases in which the phenomenon to be reproduced has been observed, and to note all the conditions which in each case accompany its production. Of all these those only can be necessary which are universally concomitant. Again he proposes to observe all the cognate cases in which, though certain of the conditions before mentioned are present, they are not accompanied by the required phenomenon. By these two classes of observations all the superfluous conditions may be rejected, and those which remain are what we seek. Wherever we can determine their existence we can produce the phenomenon in question.

This process is what Bacon calls, in *Valerius Terminus*, the freeing of a direction, and in his later writings the investigation of the Form.

His thinking that this process would in all cases, or even generally, be successful, arose from his not having sufficiently appreciated the infinite variety and complexity of Nature Thus he strongly condemns as most false and pernicious the common opinion that the num

ber of individual phenomena to be observed is sensibly infinite, and commends Democritus (a commendation which seems rather to belong to Lucretius) for having perceived that the appearance of limitless variety which the first aspect of Nature presents to us disappears on a closer inspection.

The transition from this view of Nature to the idea that it was possible to form an alphabet of the universe, and to analyse all phenomena into their real elements, is manifestly easy.

By the new method of induction it would be possible to ascertain the conditions requisite and sufficient for the production of any phenomenon; and as this determination was meant chiefly to enable us to imitate Nature, or rather to direct her operations, Bacon was naturally led to assume that the conditions in question would be such that it would in all cases be possible to produce them artificially. Now the power of man is limited to the relations of space. He brings bodies together, he separates them; but Nature must do the rest. On the other hand the conditions of the existence of any phenomenon must be something which inheres more closely in the essence of the substance by which that phenomenon is exhibited than the phenomenon itself. And this something is clearly the inward configuration of the substance; that is, the form and arrangement &c. of its ultimate particles. Whiteness, for instance, depends on an even arrangement of these particles in space; and herein we perceive a perfect analogy between what man can do and what Nature requires to be done. The familiar processes of the arts consist simply in giving particular forms to portions of matter, in arranging them and setting them in motion

according to certain rules. Between arranging stones so as to form a house, and arranging particles so as to produce whiteness, there is no difference but that of scale. So in other cases. The difference of scale once set aside, it seemed to follow that the knowledge of the Form would in all cases lead to great practical results.

Thus far of the end which the new philosophy proposes to itself, and of the method which it must employ. The next question relates to the mode of procuring and arranging the materials on which this method is to work. In this part of the subject we again perceive the influence of Bacon's opinion touching the limitedness of Nature. No one acquainted with the history of natural philosophy would think it possible to form a collection of all the facts which are to be the materials on which any science is to operate, antecedently to the formation of the science itself.

In the first place, the observations necessary in order to the recognition of these facts would never have been made except under the guidance of some preconceived idea as to the subject of observation; and in the second, the statement which embodies the result of observation always involves some portion of theory. According to the common use of language, it is a fact and not a theory that in ordinary refraction the sine of the angle of incidence is to the sine of the angle of refraction in a given ratio. But the observations on which this statement is based, and the statement itself, presuppose the recognition of a portion of the theory of light, namely that light is propagated in straight lines — in other words, they presuppose the conception of a ray Nor would these observations have been made but for the idea in the mind of the observers that the magni-

tude of the angle of refraction depends on that of the angle of incidence.

As we advance farther in any science, what we call facts involve more and more of theory. Thus it is a fact that the tangent of the angle of polarisation is equal to the index of refraction. But no one could have made the observations which prove it, or have stated their result in words, without a distinct conception, first of the law of refraction, and secondly of the distinguishing character of polarised light.

The history of science and the nature of the case concur in showing that observation and theory must go on together; — it is impossible that the one can be completed before the other begins. Now although Bacon did not think that observation and experiments might altogether be laid aside when once the process of interpretation had begun (we see on the contrary that one of the works of Solomon's House was the trying of experiments suggested by previously obtained conclusions), he certainly thought it possible so to sever observation from theory that the process of collecting facts and that of deriving consequences from them might be carried on independently and by different persons. This opinion was based on an imperfect apprehension of the connexion between facts and theories; the connexion appearing to him to be merely an external one, namely that the former are the materials of the latter. With these views that which has been already noticed touching the finiteness of Nature, namely that there are but a finite and not very large number of things which for scientific purposes require to be observed,[1] is altogether in accordance.

[1] See the Phænomena Universi, and the Partis secundæ Del., &c.

The facts on which the new philosophy was to be based, being conceivable apart from any portion of theory, and moreover not excessively numerous, they might be observed and recorded within a moderate length of time by persons of ordinary diligence.

If this registering of facts were made a royal work, it might, Bacon seems to have thought, be completed in a few years: he has at least remarked that *unless* this were done, the foundation of the new philosophy could not be laid in the lifetime of a single generation. The instauration, he has said in the general preface, is not to be thought of as something infinite and beyond the power of man to accomplish; nor does he believe that its mission can be fully completed (rem omnino perfici posse) within the limits of a single life. Something was therefore left for posterity to do; and probably the more Bacon meditated on the work he had in hand, the more was he convinced of its extent and difficulty. But the *Distributio Operis* sufficiently shows that he believed, when he wrote it, that the instauration of the sciences might speedily become an opus operatum. Of the *Historia Naturalis* on which it was to be based he there speaks, not less than of the *Novum Organum*, as of a work which he had himself accomplished, — "Tertia pars operis complectitur Phænomena Universi," — not "complecti debet." Doubtless the preface was written before the work itself was commenced; still if he had not thought it possible to make good what he here proposes to do, he would have expressly said so.[1]

[1] The sixth part, containing the new philosophy itself, is spoken of at the end of the *Distributio* as at least an inchoate work, which others must finish but to which he hopes to give "initia non contemnenda."

In a letter to Fulgenzio, written probably when Bacon was "dagli anni e da fortuna oppresso," he remarks that "these things" (the instauration of the sciences) require some ages for the ripening of them. But though he despaired of completing his design himself, and even thought that some generations must pass before it received its consummation, yet he always regarded it as a thing which sooner or later would be effectually accomplished, and which would thenceforth remain as a κτῆμα ἐς ἀεί. His instauration of the sciences had a definite end, in which when it was once attained it would finally acquiesce; nor is there anything in his writings to countenance the assumption which has been often made, that in his opinion the onward progress of knowledge was to continue throughout all time. On the contrary, the knowledge which man is capable of might, he thought, be attained, not certainly at once, but within the compass of no very long period. In this doubtless he erred; for knowledge must always continue to be imperfect, and therefore in its best estate progressive.

Bacon has been likened to the prophet who from Mount Pisgah surveyed the Promised Land, but left it for others to take possession of. Of this happy image perhaps part of the felicity was not perceived by its author. For though Pisgah was a place of large prospect, yet still the Promised Land was a land of definite extent and known boundaries, and moreover it was certain that after no long time the chosen people would be in possession of it all. And this agrees with what Bacon promised to himself and to mankind from the instauration of the sciences.

A truer image of the progress of knowledge may

be derived from the symbol which, though on other grounds, Bacon himself adopted. Those who strive to increase our knowledge of the outward universe may be said to put out upon an apparently boundless sea: they dedicate themselves

"To unpathed waters — undreamed shores;"

and though they have a good hope of success, yet they know they can subdue but a small part of the new world which lies before them.

(19.) In this respect then, as in others, the hopes of Francis Bacon were not destined to be fulfilled. It is neither to the technical part of his method nor to the details of his view of the nature and progress of science that his great fame is justly owing. His merits are of another kind. They belong to the spirit rather than to the positive precepts of his philosophy.

He did good service when he declared with all the weight of his authority and of his eloquence that the true end of knowledge is the glory of the Creator and the relief of man's estate. The spirit of this declaration runs throughout his writings, and we trust has worked for good upon the generations by which they have been studied. And as he showed his wisdom in coupling together things divine and human, so has he shown it also in tracing the demarcation between them, and in rebuking those who by confounding religion and philosophy were in danger of making the one heretical and the other superstitious.

When, not long before Bacon's time, philosophy freed itself from the tutelage of dogmatic theology, it became a grave question how their respective claims

.o authority might be most fitly co-ordinated. It was to meet, perhaps rather to evade, this question, that the distinction between that which is true in philosophy and that which is true in religion was proposed and adopted. But it is difficult to believe that the mind of any sincere and truth-loving man was satisfied by this distinction. Bacon has emphatically condemned it. "There is," he affirms, "no such opposition between God's word and his works." Both come from Him who is the father of lights, the fountain of all truth, the author of all good; and both are therefore to be studied with diligence and humility. To those who wish to discourage philosophy in order that ignorance of second causes may lead men to refer all things to the immediate agency of the first, Bacon puts Job's question, "An oportet mentiri pro Deo," — will you offer to the God of truth the unclean sacrifice of a lie?

The religious earnestness of Bacon's writings becomes more remarkable when we contrast it with the tone of the most illustrious of his contemporaries. Galileo's works are full of insincere deference to authority and of an affected disbelief in his own discoveries. Surely he who loves truth earnestly will be slow to believe that the cause of truth is to be served by irony. But we must not forget the difference between the circumstances in which the two men were placed.

Next to his determination of the true end of natural philosophy and of the relation in which it stands to natural and to revealed theology, we may place among Bacon's merits his clear view of the essential unity of science. He often insists on the importance of this

idea, and has especially commended Plato and Parmenides for affirming "that all things do by scale ascend to unity." The Creator is holy in the multitude of his works, holy in their disposition, holy in their unity: it is the prerogative of the doctrine of Forms to approach as nearly as possible towards the unity of Nature, and the subordinate science of Physics ought to contain two divisions relating to the same subject. One of these ought to treat of the first principles which govern all phenomena, and the other of the fabric of the universe.[1] All classifications of the sciences ought to be as veins or markings, and not as sections or divisions; nor can any object of scientific inquiry be satisfactorily studied apart from the analogies which connect it with other similar objects.

But the greatest of all the services which Bacon rendered to natural philosophy was, that he perpetually enforced the necessity of laying aside all preconceived opinions and learning to be a follower of Nature. These counsels could not to their full extent be followed, nor has he himself attempted to do so. But they contain a great share of truth, and of truth never more needful than in Bacon's age. Before his time doubtless the authority of Aristotle, or rather that of the scholastic interpretation of his philosophy was shaken, if not overthrown. Nevertheless the systematising spirit of the schoolmen still survived, and of the reformers of philosophy not a few attempted to substitute a dogmatic system of their own for that from which they dissented.

Nor were these attempts unsuccessful. For men

[1] The latter is in effect what is now called Kosmos.

still leaned upon authority, and accepted as a test of truth the appearance of completeness and scientific consistency. This state of things was one of transition; and probably no one did more towards putting an end to it than Bacon. To the dealers in systems and to their adherents he opposed the solemn declaration, that they only who come in their own name will be received of men. He constantly exhorted the seeker after truth to seek it in intercourse with Nature, and has repeatedly professed that he was no founder of a sect or school. He condemned the arrogance of those who thought it beneath the dignity of the philosopher to dwell on matters of observation and experiment, and reminded them that the sun "æque palatia et cloacas ingreditur; nec tamen polluitur." We do not, he continues, erect or dedicate to human pride a capitol or a pyramid; we lay the foundations in the mind of man of a holy temple, whereof the exemplar is the universe. Throughout his writings the rejection of systems and authority is coupled with the assertion, that it is beyond all things necessary that the philosopher should be an humble follower of Nature. One of the most remarkable parts of the *Novum Organum* is the doctrine of Idola. It is an attempt to classify according to their origin the false and ill-defined notions by which the mind is commonly beset. They come, he tells us, from the nature of the human mind in general, from the peculiarities of each man's individual mind, from his intercourse with other men, from the formal teaching of the received philosophies. All these must be renounced and put away, else no man can enter into the kingdom which is to be founded on the knowl-

edge of Nature.[1] Of the four kinds of idols Mersenne has spoken in his *Vérité des Sciences*, published in 1625, as of the four buttresses of the *Organum* of Verulam. This expression, though certainly inaccurate, serves to show the attention which in Bacon's time was paid to his doctrine of idola.[2]

His rejection of syllogistic reasoning in the proposed process for the establishment of axioms, was not without utility. In the middle ages and at the reform of philosophy the value of the syllogistic method was unduly exalted. Bacon was right in denying that it was possible to establish by a summary process and à priori the first principles of any science, and thence to deduce by syllogism all the propositions which that science could contain; and though he erred in rejecting deductive reasoning altogether, this error could never have exerted any practical influence on the progress of science, while the truth with which it was associated was a truth of which his contemporaries required at least to be reminded. The reason of his error seems to have been that he formed an incorrect idea of the nature of syllogism, regarding it rather as an entirely artificial process than as merely a formal statement of the steps necessarily involved in every act of reasoning. However this may be, it is certain that whenever men attempted to set aside every process for the discovery of truth except induction, they must always have been led to recognise the impossibility of doing so.

Lastly, the tone in which Bacon spoke of the future destiny of mankind fitted him to be a leader of the age

[1] Nov. Org. i. 68. The word idolon is used by Bacon in antithesis to idea. He does not mean by it an idol or false object of worship.

[2] Compare Gassendi, Inst. Log.

in which he lived. It was an age of change and of hope. Men went forth to seek in new-found worlds for the land of gold and for the fountain of youth; they were told that yet greater wonders lay within their reach. They had burst the bands of old authority; they were told to go forth from the cave where they had dwelt so long, and look on the light of heaven. It was also for the most part an age of faith; and the new philosophy upset no creed, and pulled down no altar. It did not put the notion of human perfectibility in the place of religion, nor deprive mankind of hopes beyond the grave. On the contrary, it told its followers that the instauration of the sciences was the free gift of the God in whom their fathers had trusted — that it was only another proof of the mercy of Him whose mercy is over all his works.

PHILOSOPHICAL WORKS.

PART I.

WORKS PUBLISHED, OR DESIGNED FOR PUBLICATION, AS PARTS OF THE INSTAURATIO MAGNA;

ARRANGED

ACCORDING TO THE ORDER IN WHICH THEY WERE WRITTEN.

Consilium est universum opus Instaurationis potius promovere in multis quam perficere in paucis; hoc perpetuo maximo cum ardore (qualem Deus mentibus ut plane confidimus addere solet) appetentes; ut quod adhuc nunquam tentatum sit id ne jam frustra tentetur. — *Auctoris Monitum*, 1622.

NOVUM ORGANUM.

NOTE.

Mr. Ellis's preface to the *Novum Organum* was written when he was travelling abroad and had not his books of reference about him. He was at work upon it the night he was taken ill at Mentone, and was not afterwards able either to finish or to revise it. I have added a page or two at the end, by which the analysis of the first book is completed. Of the second book it was not necessary to say anything; the subject of it being Bacon's *method*, which has been fully discussed in the General Preface. A few bibliographical inaccuracies of little consequence in themselves I have corrected, either in notes or by the insertion of words within brackets. These were merely oversights, hardly avoidable in the first draft of a work written in such circumstances. But there are also a few opinions expressed incidentally in which I cannot altogether concur, though they have evidently been adopted deliberately. With regard to these (Mr. Ellis not being in a condition to enter into a discussion of them) I had no course but to explain the grounds of my dissent, and leave every man to decide for himself upon the questions at issue. To avoid inconvenient interruptions however, I have thrown my arguments into an appendix, and contented myself in the foot notes with marking the particular expressions which I hold to be questionable. — *J. S.*

PREFACE TO THE NOVUM ORGANUM.

BY ROBERT LESLIE ELLIS.

THE *Novum Organum* was published in 1620. Certain prolegomena to the whole of the Instauratio were prefixed to it, namely a Proœmium beginning "Franciscus de Verulamio sic cogitavit," a dedication to King James, a general preface, and an account, entitled Distributio Operis, of the parts of which the Instauratio was to consist. Of these the *Novum Organum* is the second; the *De Augmentis*, which was not then published, occupying the place of the first. Accordingly in most editions of Bacon's works the prolegomena are prefixed, not to the *Novum Organum*, but to the *De Augmentis;* and this is doubtless their natural place. Nevertheless as Bacon's general design was not completed, it seems better to allow them to remain in their original position, especially as in the Proœmium Bacon explains why he publishes one portion of the Instauratio apart from the rest. "Decrevit," he there says, speaking of himself, "prima quæque quæ perficere licuit in publicum edere. Neque hæc festinatio ambitiosa fuit, sed sollicita, ut si quid illi humanitus accideret, exstaret tamen designatio quædam ac destinatio rei quam animo complexus est," &c.

After the Proœmium and the dedication we come to

the Præfatio Generalis, in which Bacon speaks of the unprosperous state of knowledge and of the necessity of a new method; and then follows the Distributio Operis. The Instauratio is to be divided into six portions, of which the first is to contain a general survey of the present state of knowledge. In the second men are to be taught how to use their understanding aright in the investigation of Nature. In the third all the phenomena of the universe are to be stored up as in a treasure-house, as the materials on which the new method is to be employed. In the fourth examples are to be given of its operation and of the results to which it leads. The fifth is to contain what Bacon had accomplished in natural philosophy without the aid of his own method, but merely "ex eodem intellectûs usu quem alii in inquirendo et inveniendo adhibere consueverunt." It is therefore less important than the rest, and Bacon declares that he will not bind himself to the conclusions it contains. Moreover its value will altogether cease when the sixth part can be completed, wherein will be set forth the new philosophy — the result of the application of the new method to all the phenomena of the universe. But to complete this, the last part of the Instauratio, Bacon does not hope: he speaks of it as a thing "et supra vires et ultra spes nostras collocata."

The greater part of the plan traced in the Distributio remained unfulfilled. Not to speak of the last division of the Instauratio, no part of Bacon's writings can properly be referred either to the fourth or fifth, except two prefaces which are found among the fragments published by Gruter.[1] To the fifth division

[1] Francisci Baconi de Verulamio Scripta in naturali et universali Phil-

however M. Bouillet[1] is disposed to refer several of Bacon's philosophical writings; as, for instance, the tracts entitled *De Fluxu et Refluxu Maris*, and *Thema Cœli*. But though they correspond with the description which Bacon gives of the contents of the fifth part of the Instauratio, there is no reason to suppose that they would have been comprised in it. They were written a considerable time before the publication of the *Novum Organum;* the *Thema Cœli* being clearly of the same date as the *Descriptio Globi intellectualis*, written in 1612,[2] and the *De Fluxu et Refluxu Maris* being probably written before Bacon had become acquainted with Galileo's theory of the tides. This theory was published in 1616; and it is reasonable to suppose that Bacon, who speaks of it in the *Novum Organum*, would have mentioned it in the *De Fluxu*, if the latter had not been written either before it was published, or but a short time afterwards.[3] These tracts, and the others which M. Bouillet mentions, are clearly occasional writings not belonging to the circuit of the Instauratio.

osophia. Amst. 1653. For a particular account of this volume, see my preface to Part III.* — *J. S.*

[1] Œuvres Philosophiques de Bacon, publiées d'après les textes originaux, avec notice, sommaires et éclaircissemens, par M. N. Bouillet. Paris, 1834. — *J. S.*

[2] See the Preface to the *Descriptio Globi intellectualis.** — *J. S.*

[3] That the *De Fluxu* was written before the *Thema Cœli* is almost proved by the allusion to it in the following passage: "Verum hujusce rei demonstrationes et evidentias in anticipatione nostrâ de fluxu et refluxu maris plene tractavimus." I say *almost* proved, because Bacon in writing a piece which was designed to come after another which was not yet written, would sometimes refer to that other as if it were already done. But it is not likely that he should have done so here; for in any general scheme the *Thema Cœli* would have come before the *De Fluxu*. In a letter to Bacon, dated 14th April 1619, Tobie Matthew speaks of Galileo's having *answered* Bacon's discourse touching the flux and reflux of the sea: but he alludes apparently to a discourse of Galileo's on that subject which had never been printed. — *J. S.*

* [Complete Works.]

To the fourth part have been referred the *Historia Ventorum*, the *Historia Vitæ et Mortis*, &c. This however is contrary to Bacon's description of them in the dedication to Prince Charles prefixed to the *Historia Ventorum*. They are there spoken of as the "primitiæ Historiæ nostræ naturalis." Even the general title with which the *Historia Ventorum* and the titles of five other Historiæ were published, shows that they belong not to the fourth but to the third part of the Instauratio. It is as follows: — *Historia Naturalis ad condendam Philosophiam, sive Phænomena Universi, quæ est Instaurationis Magnæ pars tertia.* It is moreover manifest that as the fourth part was to contain applications to certain subjects of Bacon's method of induction, these treatises, in which the method is nowhere employed, cannot belong to it. M. Bouillet, though he justly dissents from Shaw's[1] arrangement, by whom they are referred to the fourth part, nevertheless commits an error of the same kind by introducing into this division of the Instauratio a fragment on Motion, published by Gruter with the title *Filum Labyrinthi, sive Inquisitio legitima de Motu.* This fragment, which is doubtless anterior to the *Novum Organum*, contains many thoughts and expressions which are found more perfectly developed either in the *Novum Organum* itself, or in the Distributio Operis. It is not to be supposed that Bacon, after thus expressing himself in the Distributio — "Neque enim hoc siverit Deus ut phantasiæ nostræ somnium pro exemplari mundi edamus; sed potius

[1] The Philosophical Works of Francis Bacon, Baron of Verulam, &c. methodised and made English from the Originals, by Peter Shaw, M.D London, 1733. — *J. S.*

benigne faveat ut apocalypsim ac veram visionem vestigiorum et sigillorum Creatoris super creaturas scribamus" — would have repeated this remarkable sentence with scarcely any alteration in another part of the Instauratio;[1] nor that he would have repeated in a somewhat less finished form the whole substance of the hundred and twenty-fifth aphorism of the first book of the *Novum Organum*. Yet we must admit this improbable supposition, if we decide on giving to the *Inquisitio legitima* the place which M. Bouillet has assigned to it. The truth is, that many of Bacon's shorter tracts preserved by Gruter and others are merely, so to speak, experimental fragments, of which the substance is embodied in his more finished writings.

Of the fourth and fifth parts of the Instauratio nothing, as I have already remarked, has been preserved except the prefaces, if indeed any other portion of them ever existed. But of the third, though it is altogether incomplete, we have nevertheless large fragments. Two years after the publication of the *Novum Organum* Bacon published the *Historia Naturalis ad condendam Philosophiam*, which has been al-

[1] I doubt whether this argument can be safely relied upon. Among the works which were certainly meant to stand as part of the Instauratio several remarkable passages occur twice and more than twice. But there are other grounds for concluding that the *Inquisitio de Motu* was written soon after the *Cogitata et Visa* (1607). In the *Commentarius solutus*, a kind of diary which will be printed among the Occasional Works,* I find the following entry under the date July 26. 1608: — "The finishing the 3 tables *De Motu, De Calore et Frigore, De Sono.*" After which follow (July 27.) several pages of notes for an *Inquisitio legitima de Motu*. It would seem that this *Inquisitio* was designed originally to be the example in which the new method was to be set forth (see last section of *Cogitata et Visa*), but that the *Inquisitio de Calore et Frigore* was afterwards preferred; probably as more manageable. — *J. S.*

* [Not included in this edition.]

ready mentioned. In this however only the *Historia Ventorum* is contained in extenso; and of the five other Historiæ of which Bacon speaks in the dedication, and of which he proposed to publish one every month, only two are now in existence, namely the *Historia Vitæ et Mortis*, published in 1623, and the *Historia Densi et Rari* which is contained in Rawley's *Opuscula varia posthuma*, published in 1658. Of the other three, namely the Historiæ *Gravis et Levis*, *Sympathiæ et Antipathiæ Rerum*, and *Sulphuris Mercurii et Salis*, we have only the prefaces, which were published in the same volume as the *Historia Ventorum*.

These Historiæ, and the *Sylva Sylvaram*, published soon after Bacon's death by Rawley, are the only works which we are entitled to refer to the third part of the Instauratio. With respect to the former we have the authority of Bacon's own title page and dedication; and Rawley's dedication of the latter to King Charles shows that it is included under the general designation of *Historia Naturalis ad condendam Philosophiam*.[1]

Other tracts however, of more or less importance, have been placed in the third part of the Instauratio, as for instance a fragment, published by Rawley in 1658, entitled *Historia et Inquisitio prima de Sono et Auditu et de Formâ Soni et latente processu Soni, sive Sylva Soni Auditus*. But the substance of this fragment occurs also in the *Sylva Sylvarum*, and therefore

[1] "The whole body of the *Natural History*, either designed or written by the late lord Viscount St. Albans, was dedicated to Your Majesty in the book *De Ventis*, about four years past, when Your Majesty was prince, so as there needed no new dedication of this work, but only in all humbleness to let Your Majesty know that is yours." — *Dedication to the King of the Sylva Sylvarum.*

it cannot have been Bacon's intention to publish both as portions of his *Historia Naturalis*. It is probable that the *Historia de Sono et Auditu* was originally written as a portion of the general scheme of natural history[1] which was to form the third part of the Instauratio; but it is certainly superseded by the *Sylva Sylvarum*, and is therefore not entitled to the position which has generally been assigned to it. So, too, the *Historiæ Naturalis ad condendam Philosophiam Præfatio destinata*,[2] published by Gruter, is clearly irreconcilable with the plan laid down in the dedication to Prince Charles of the *Historia Naturalis*. For Bacon's intention when he wrote the preface which Gruter has published was plainly to commence his *Natural History* by treating of density and rarity, and not of the natural history of the winds. Subsequently he changed his plan; and the first published portion of the third part of the Instauratio is, as we have seen, the *Historia Ventorum*. But this change of plan plainly shows that he had determined to cancel the fragment preserved by Gruter. Whenever what an author publishes or prepares for publication supersedes or contradicts unpublished and unfinished papers, these ought beyond all question to be set aside, and if published at all to be published

[1] It was probably the table *De Sono* referred to in the *Commentarius solutus*, July 26. 1608 (see note 1. p. 135.), and designed, like the tables *De Motu* and *De Calore et Frigore*, for an example of the new method. — *J. S.*

[2] See Bouillet, vol. ii. p. 264. The preface in question is the introduction to the *Tabula Exporrectionis et Expansionis Materiæ*, a rudiment of the *Historia Densi et Rari*. It was published by Gruter, before the *Historia Densi et Rari* appeared, among the *Impetus Philosophici:* with the title, *Phænomena Universi; sive Historia Naturalis ad condendam Philosophiam. Præfatio.* M. Bouillet gives the preface only. The whole tract as given by Gruter will be found in Part III. of this edition.* — *J. S.*

* [Complete Works.]

apart from his other writings. Against some of the other fragments included in the third part of the Instauratio there is no such direct evidence as there is against those of which we have been speaking; but it only gives rise to needless confusion to mix up with what we know it was Bacon's intention to publish as portions of his *Historia Naturalis*, loose fragments touching which we have no information whatever.

From what has been said it is manifest that what we possess of the third part of the Instauratio is merely a fragment — for the *Sylva Sylvarum*, a miscellaneous collection of observations gathered for the most part out of books, nowise completes Bacon's general design. In truth it is a design which cannot be completed, there being no limit to the number of the "Phænomena universi" which are potentially if not actually cognisable; and it is to be observed that even if all the facts actually known at any instant could be collected and systematised (and even this is plainly impossible), yet still Bacon's aim would not be attained. For these facts alone would be insufficient as materials for the sixth part of the Instauratio, in which was to be contained all the knowledge of Nature man is capable of. Every day brings new facts to light not less entitled than those previously known to find a place in a complete description of the phenomena of the universe.[1] From many places in Ba-

[1] This would be true, I think, of all new facts which were not obviously reconcilable with laws previously known. But is it not conceivable that so complete a knowledge might be attained of the *laws* of Nature, that it could not be increased or affected by the discovery of any new *fact* in Nature? If we had as complete a knowledge of other laws of Nature as we have of gravitation, for instance, new facts would still come to light, but with respect to the laws themselves they would all say the same thing, and there-

con's writings it appears, as I have elsewhere remarked, that he had formed no adequate conception of the extent and variety of Nature. In a letter to R. P. Baranzan, who had apparently remarked by way of objection to Bacon's scheme of philosophy that a complete natural history would be a work of great extent and labour, Bacon observes that it would perhaps be sixfold as voluminous as that of Pliny. We have here therefore a sort of estimate of the limits which, in his judgment, the third part of the Instauratio would not exceed. What now exists of it is perhaps one twentieth in magnitude of this estimate.

Even the second part of the Instauratio, the *Novum Organum* itself, is incomplete. The second book concludes with the doctrine of prerogative instances. But in its twenty-first aphorism a number of subjects are mentioned of which this doctrine is the first, the last being the "Scala ascensoria et descensoria axiomatum." Neither this, nor any of these subjects after the first, except the last but one, is anywhere discussed in Bacon's writings; and our knowledge of his method is therefore incomplete. Even the penultimate division of the *Novum Organum* which was published along with the first two books, and which treats "de parascevis ad inquisitionem," has all the appearance of being a fragment, or at least of being less developed than Bacon had intended it to be.

fore bring no new knowledge. Every new application of mechanical power contains some new *fact* more or less connected with gravitation; yet unless a machine can be made which shall produce results not only new (i. e. such as had never been produced before) but inexplicable by he received theory of gravitation, are we not entitled to say that we know all that can be known about gravitation? — *J. S.*

The first part of the Instauratio is represented, not inadequately, by the *De Augmentis*, published about three years after the Distributio Operis and the *Novum Organum*. It is a translation with large additions of the *Advancement of Learning*, published in 1605; and if we regard the latter as a development of the ninth chapter of *Valerius Terminus*, which is an early fragment containing the germ of the whole of the Instauratio,[1] the *De Augmentis* will appear to belong naturally to the great work of which it now forms the first and only complete portion. In the preface prefixed to it by Rawley it is said that Bacon, finding "the part relating to the Partitions of the Sciences already executed, though less solidly than the dignity of the argument demanded, . . . thought the best thing he could do would be to go over again what he had written, and to bring it to the state of a satisfactory and completed work. And in this way he considers that he fulfils the promise which he has given respecting the first part of the Instauration."[2]

From this general view of the different parts of the Instauratio, as described in the Distributio Operis, we proceed to consider more particularly the *Novum Organum*. Although it was left incomplete, it is nevertheless of all Bacon's works that upon which he bestowed the most pains. In the first book especially every word seems to have been carefully weighed; and

[1] I should rather say, the germ of all that part of the Instauratio which treated of the Interpretation of Nature. For I cannot find in the *Valerius Terminus* any traces of the *first* part, of which the *Advancement of Learning* was the germ. See Note A. at the end. — *J. S.*

[2] My own reasons for thinking that the *De Augmentis* did *not* form part of the original design, together with the circumstances which, as I suppose, determined Bacon to enlarge that design so as to take it in, will be explained in the preface to the *De Augmentis* [Complete Works]. — *J. S.*

it would be hard to omit or to change anything without injuring the meaning which Bacon intended to convey. His meaning is not always obvious, but it is always expressed with singular precision and felicity. His chaplain, Rawley, says that he had seen among his papers at least twelve yearly revisions of the *Novum Organum*.[1] Assuming, which there is no reason to doubt, that this statement may be relied upon, it would seem to follow that the composition of the *Novum Organum* commenced in 1608. And this agrees tolerably well with the circumstance that the *Cogitata et Visa* was sent to Bodley in 1607, as we learn from the date of Bodley's reply to it. If we suppose that the tract published with this title by Gruter is the same as that which was sent to Bodley, a passage near the end acquires a significance which has not I think been remarked. In the *Cogitata et Visa* Bacon speaks of the considerations whereby he had been led to perceive the necessity of a reform in philosophy, and goes on to say that the question as to how his new method might be most fitly given to the world had been much in his thoughts. "Atque diu," he proceeds, "et acriter rem cogitanti et perpendenti ante omnia visum est ei tabulas inveniendi, sive legitimæ inquisitionis formulas . . . in aliquibus subjectis

[1] "Ipse reperi in archivis Dominationis suæ a utographa plusminus duodecim *Organi novi*, de anno in annum elaborati et ad incudem revocati; et singulis annis ulteriore limâ subinde politi et castigati." In the preceding sentence, he calls it "multorum annorum et laboris improbi proles." — *Auctoris Vita*, prefixed to the *Opuscula varia posthuma*, 1658. In the English Life prefixed to the *Resuscitatio*, which was published the year before, he says "I myself have seen at the least twelve copies of the Instauration; revised year by year, one after another; and every year altered and amended in the frame thereof." I doubt whether we can fairly infer from these expressions that these twelve several copies were made in twelve several years; but substantially they bear out the inference drawn from them. —*J. S.*

proponi tanquam ad exemplum et operis descriptionem fere visibilem.[1] . . . Visum est autem, nimis abruptum esse ut à tabulis ipsis docendi initium sumatur. Itaque idonea quædam præfari oportuisse, quod et jam se fecisse arbitratur." It was Bacon's intention therefore when he wrote the *Cogitata et Visa*, and when apparently some years later[2] he communicated it to Bodley, to publish an example of the application of his method to some particular subject — an intention which remained unfulfilled until the publication of the *Novum Organum*. We may therefore conjecture that it was about this time that Bacon addressed himself to the great work of composing the *Novum Organum;*[3] and this agrees with what Rawley says of its having been twelve years in hand. This view also explains why the whole

[1] In the *Commentarius solutus*, under date July 26, 1608, I find the following memorandum: — "Seeing and trying whether the B. of Canterb. may not be affected in it, being single and glorious, and believing the sense.

"Not desisting to draw in the Bp. Awnd. [Bishop Andrews, probably] being single, rich, sickly, and professor to some experiments: *this after the table of motion or some other in part set in forwardness.*"

Some other memoranda in the same place relate to the gaining of *physicians*, and learning from them experiments of surgery and physic; which explains the epithet "sickly" in the above extract. — *J. S.*

[2] Bodley's answer is dated Feb. 19. 1607; i. e. 1607–8; in which he says, "I must tell you, to be plain, that you have very much wronged yourself and the world, to smother such a treasure so long in your coffer." But I do not think we can infer from this that the *Cogitata et Visa* had been *written* "some years" before. Bodley may only allude to his having kept such thoughts so long to himself. — *J. S.*

[3] In the *Commentarius solutus*, under date July 26 1608, I find the following memorandum: — "The finishing the Aphorisms, *Clavis interpretationis*, and then setting forth the book," and in the same page, a little after, "Imparting my *Cogitata et Visa*, with choice, ut videbitur." The aphorisms here spoken of may have been the "Aphorismi et Consilia de auxiliis mentis et accensione luminis naturalis;" a fragment containing the substance of the first, second, and third aphorisms of the first book of the *Novum Organum*, and the first, third, and sixteenth of the second. *Clavis interpretationis* was probably the name which was afterwards exchanged for *Novum Organum*. — *J. S.*

substance of the *Cogitata et Visa* is reproduced in the first book of the *Novum Organum;* for this tract was designed to be an introduction to a particular example of the new method of induction, such as that which we find near the beginning of the second book. Bacon's purpose in writing it was therefore the same as that which he had in view in the first book of the *Novum Organum*, — namely to procure a favourable reception for an example and illustration of his method. What has been said may be in some measure confirmed by comparing the *Cogitata et Visa* with an earlier tract, — namely the *Partis secundæ Delineatio et Argumentum.* When he wrote this tract Bacon did not propose to set forth his method merely by means of an example; on the contrary, the three ministrations to the sense, to the memory, and to the reason, of which the last is the new method of induction, were to be set forth in order and didactically. Whereas in the *Novum Organum* Bacon remarks, "incipiendum est à fine" (that is, the method of induction must be set forth before the method of collecting facts and that of arranging them so as best to assist the memory); and having said this, he goes on at once to his example, — namely, the investigation of the Form of heat. Thus it appears that after Bacon had not only decided on writing a great work on the reform of philosophy, but had also determined on dividing it into parts of which the second was to contain the exposition of his new method, he in some measure changed his plan, and resolved to set forth the essential and operative part of his system chiefly by means of an example. This change of plan appears to be marked by the *Cogitata et Visa*, — a circumstance which makes this tract one of the most interesting of the precursors of the *Novum Organum.*

That the *Partis secundæ Delineatio* is earlier than the *Cogitata et Visa* appears plainly from several considerations which M. Bouillet, who expresses a contrary opinion, seems to have overlooked. In the first place, whole sentences and even paragraphs of the *Cogitata et Visa* are reproduced with scarcely any alteration in the *Novum Organum;* whereas this is by no means the case with any passage of the *Partis secundæ Delineatio.* But as it may be said that this difference arises from the different character of the two tracts, of which the one is simply a summary of a larger work, whereas the more developed style of the other resembles that of the *Novum Organum*, it may be well to compare them somewhat in detail.

In speaking of the prospects which the reform of philosophy was to open to mankind, Bacon thus expresses himself in the *Novum Organum :* — "Quinetiam prudentia civilis ad consilium vocanda est et adhibenda, quæ ex præscripto diffidit, et de rebus humanis in deterius conjicit." The corresponding sentence in the *Cogitata et Visa* is, "Consentaneum enim esse, prudentiam civilem in hâc parte adhibere, quæ ex præscripto diffidit et de humanis in deterius conjicit." Again, in the *Partis secundæ Delineatio* the same idea is thus expressed, "Si quis sobrius (ut sibi videri possit), et civilis prudentiæ diffidentiam ad hæc transferens, existimet hæc quæ dicimus votis similia videri," &c. Here the somewhat obscure phrase "civilis prudentiæ diffidentiam" is clearly the germ of that by which it is replaced in the other two passages, namely, "prudentia civilis quæ ex præscripto diffidit." Again, in the *Partis secundæ Delineatio* Bacon affirms that ordinary induction "puerile quiddam est et precario concludit, peric-

ulo ab instantiâ contradictoriâ exposita:" in the *Cogitata et Visa*, that the logicians have devised a form of induction "admodum simplicem et plane puerilem, quæ per enumerationem tantum procedat, atque propterea precario non necessario concludat." The clause "quæ per enumerationem tantum procedat," which adds greatly to the distinctness of the whole sentence, is retained in the Distributio Operis, in which it is said that the induction of the logicians, "quæ procedit per enumerationem simplicem, puerile quiddam est, precario concludit, et periculo ab instantiâ contradictoriâ exponitur." To take another case: in the *Partis secundæ Delineatio*, Bacon, speaking of those who might object to his frequent mention of practical results as a thing unworthy of the dignity of philosophy, affirms that they hinder the accomplishment of their own wishes. "Quin etiam illis, quibus in contemplationis amorem effusis frequens apud nos operum mentio asperum quiddam atque ingratum et mechanicum sonat, monstrabimus quantum illi desideriis suis propriis adversentur, quum puritas contemplationum atque substructio et inventio operum prorsus eisdem rebus nitantur, ac simul perficiantur." In the *Cogitata et Visa*, this sentence recurs in a modified and much neater form: — "Si quis autem sit cui in contemplationis amorem et veneration-nem effuso ista operum frequens et cum tanto honore mentio quiddam asperum et ingratum sonet, is pro certo sciat se propriis desideriis adversari; etenim in naturâ, opera non tantum vitæ beneficia, sed et veritatis pignora esse." On comparing these two sentences, it is difficult to believe that Bacon would have omitted the antithesis with which the latter ends in order to introduce the somewhat cumbrous expressions which

correspond to it in the former, especially as we find this antithesis reproduced, though with another context, in the *Novum Organum*. "Opera ipsa," it is there said, "pluris facienda sunt quatenus sunt veritatis pignora quam propter vitæ commoda." [1]

These instances will probably be thought sufficient to justify us in concluding that the *Partis secundæ Delineatio*, in which no mention is made of the plan of setting forth the new method of induction by means of an example, is of earlier date than the *Cogitata et Visa*, in which this plan, actually employed in the *Novum Organum*, is spoken of as that which Bacon had decided on adopting. This question of priority is not without interest; for if the *Partis secundæ Delineatio* is anterior to the *Cogitata et Visa*, the general plan of the Instauratio must have been formed a considerable time before 1607, about which time Bacon probably commenced the composition of the *Novum Organum*. If we could determine the date of *Valerius Terminus*, we should be able to assign limits within which the formation of this plan, so far as relates to the division of the work into six portions, may be supposed to lie. For the first book of *Valerius Terminus* was to include all that was to precede the exposition of the new method of induction, which was to be the subject of the second; that is, it was to comprehend, along with the first part of the Instauratio,[2] the general reflexions and precepts which form the subject of the first book

[1] Nov. Org. i. 124. It is well to mention that some of the expressions in this aphorism which do not occur in the *Cogitata et Visa* will be found in the *Partis secundæ Delineatio*. But it will be observed that I am only comparing passages which occur in all three works. Of the greater general resemblance of the *Cogitata et Visa* to the *Novum Organum* there can be no question.

[2] Query. See Note A. at the end, § 1. — *J. S.*

of the *Novum Organum.* Nor does it appear that *Valerius Terminus* was to contain anything corresponding to the last four parts of the Instauratio;[1] it was a work, as its title[2] shows, on the Interpretation of Nature; that is, it was to be a statement of Bacon's method, without professing either to give the collection of facts to which the method was to be applied, or the results thereby obtained. Unfortunately, there appears to be no evidence tending to enable us to assign the time at which (or not long after it) *Valerius Terminus* was written. That it is earlier than the *Advancement of Learning* seems to follow from the circumstance that Bacon, when he wrote it, designed to include in a single chapter the general survey of human knowledge which in the *Advancement* is developed into two books.[3] Bacon has on all occasions condemned epitomes, and it is therefore altogether improbable that after writing the *Advancement of Learning* he would have endeavoured to compress its contents, or even those of the second book, within the limits proposed in *Valerius Terminus.* On the other hand, we may suppose that before writing the *Advancement* he had not seen how much he had to say on the subject to which it relates. We may conclude therefore, on these and other grounds, that *Valerius Terminus* was written some time before 1605: how much before cannot be known; but as by comparing the *Partis secundæ Delineatio* and the *Cogitata et Visa* with the *Novum Organum* we have seen reason to conclude that the general plan of the Instauratio was formed before Bacon had decided on propounding

[1] Query. See Note A. at the end, § 2. — *J. S.*

[2] "Valerius Terminus of the Interpretation of Nature; with the Annotations of Hermes Stella. A few fragments of the first book, viz.," &c.

[3] Query. See Note A. at the end, § 1. — *J. S.*

his method by means of an example, so by comparing the first-named of these three works with *Valerius Terminus*, we perceive that the idea of the work on the Interpretation of Nature, that is, on the new method of induction, was anterior in Bacon's mind to that of the Instauratio.

And this conclusion is confirmed by all we know of Bacon's early writings. In the earliest of all, (if we assume that the *Temporis Partus Masculus*, published by Gruter,[1] is the same as the *Temporis Partus Maximus* mentioned by Bacon in his letter to Fulgenzio,) the most prominent notion is that true science consists in the interpretation of Nature — a phrase by which Bacon always designates a just method of induction. But nothing is said either there or in any early fragment whereby we are led to suppose that Bacon then thought of producing a great work like the Instauratio. On the contrary, in the *De Interpretatione Naturæ Proœmium* he proposes to communicate his peculiar method and the results to which it was to lead, only to chosen followers; giving to the world merely an exoteric doctrine, namely the general views of science which afterwards formed the substance of the *Cogitata et Visa* and ultimately of the first book of the *Novum Organum*.[2]

From what has been said it follows that we should form an inadequate conception of the *Novum Organum* if we were to regard it merely as a portion of the Instauratio. For it contains the central ideas of Bacon's system, of which the whole of the Instauratio is only the developement. In his early youth Bacon formed

[1] Say rather, "the several tracts collected by M. Bouillet under the title *Temporis Partus Masculus*." See Note A. at the end, § 3. — *J. S.*

[2] See Note A. at the end, § 4. — *J. S.*

the notion of a new method of induction, and from that time forth this notion determined the character of all his speculations. Later in life he laid the plan of a great work, within the limits of which the materials to which his method was to be applied and the results thereby to be obtained might be stored up, together with a statement of the method itself. But of this great plan the interpretation of Nature was, so to speak, the soul, — the formative and vivifying principle; not only because Bacon conceived that the new method only could lead to the attainment of the great ends which he had in view, but also because it was the possession of this method which had suggested to him the hopes which he entertained.[1] There seems some reason to believe that his confidence in his peculiar method of induction did not increase as he grew older; that is to say, he admits in the *Novum Organum* that the interpretation of Nature is not so much an artificial process as the way in which the mind would naturally work if the obstacles whereby it is hindered in the pursuit of truth were once set aside.[2] So that his pre-

[1] I quite agree in this, but not quite on the same grounds. In Note A. at the end of this preface, the reader will find a statement, too long for a footnote, of such points in the foregoing argument as I consider disputable. It was the more necessary to point them out, because the arrangement of the pieces in this edition, for which I am responsible, will otherwise create a difficulty; being in some respects inconsistent with the opinions here expressed. — *J. S.*

[2] Nov. Org. i. 130. "Est enim Interpretatio verum et naturale opus mentis, demptis iis quæ obstant." But compare the following passage in *Valerius Terminus*, c. 22. "that it is true that interpretation is the very natural and direct intention. action, and progression of the understanding, delivered from impediments. And that all anticipation is but a reflexion or declination by accident." So that if we may infer from the passage in the *Novum Organum* that his confidence had abated, we must suppose that when he wrote the *Valerius Terminus* it had not risen to its height. But for my own part I doubt whether his opinion on this point ever changed.—*J. S.*

cepts are, he says, not of absolute necessity: "necessitatem ei (arti interpretationis scilicet) ac si absque eâ nil agi possit, aut etiam perfectionem non attribuimus," — an admission not altogether in the spirit of the earlier writings in which the art of interpretation is spoken of as a secret of too much value to be lightly revealed.[1]

If it be asked why Bacon determined on propounding his method by means of an example, the answer is to be sought for in the last paragraphs of the *Cogitata et Visa*. He seems to have thought that it would thus obtain a favourable reception, because its value would be to a certain extent made manifest by the example itself. Likewise he hoped in this way to avoid all occasion of dispute and controversy, and thought that an example would be enough to make his meaning understood by all who were capable of understanding it. "Fere enim se in eâ esse opinione, nempe (quod quispiam dixit) prudentibus hæc satis fore, imprudentibus autem ne plura quidem."

His expectations have not been fulfilled, for very few of those who have spoken of Bacon have understood his method, or have even attempted to explain its distinguishing characteristics, namely the certainty of its results, and its power of reducing all men to one common level.

Another reason for the course which he followed may not improbably have been that he was more or less conscious that he could not demonstrate the valid-

[1] Not, I think, as a secret of too much value to be revealed, but as an argument too abstruse to be made popular. See Note B. at the end, where I have endeavoured to bring together all the evidence upon which the presumption in the text is founded, and to show that it proves either too much or too little. — *J. S.*

ity, or at least the practicability, of that which he proposed. The fundamental principle in virtue of which alone a method of exclusions can necessarily lead to a positive result, namely that the subject matter to which it is applied consists of a finite number of elements, each of which the mind can recognise and distinguish from the rest, cannot, it is manifest, be for any particular case demonstrated à priori. Bacon's method in effect assumes that substances can always be resolved into an aggregation of a certain number of abstract qualities, and that their essence is adequately represented by the result of this analysis. Now this assumption or postulate cannot be made the subject of a direct demonstration, and probably Bacon came gradually to perceive more or less the difficulties which it involves. But these difficulties are less obvious in special cases than when the question is considered generally, and on this account Bacon may have decided to give instead of a demonstration of his method an example of its use. He admits at the close of the example that the operation of the method is imperfect, saying that at first it could not but be so, and implying that its defects would be removed when the process of induction had been applied to rectify our notions of simple natures. He thus seems to be aware of the inherent defect of his method, namely that it gives no assistance in the formation of conceptions, and at the same time to hope that this would be corrected by some modification of the inductive process. But of what nature this modification is to be he has nowhere stated; and it is to be remarked that in his earliest writings the difficulty here recognised is not even mentioned. In *Valerius Terminus* nothing is said of the

necessity of forming correct notions of simple natures, — the method of exclusions then doubtless appearing to contain all that is necessary for the investigation of Nature.

Bacon may also have been influenced by other considerations. We have seen that he was at first unwilling that his peculiar method should become generally known. In the *De Interpretatione Naturæ Proœmium* he speaks of its being a thing not to be published, but to be communicated orally to certain persons.[1] In *Valerius Terminus* his doctrine was to be veiled in an abrupt and obscure style,[2] such as, to use his own expression, would choose its reader, — that is, would remain unread except by worthy recipients of its hidden meaning. This affected obscurity appears also in the *Temporis Partus Masculus.* In this unwillingness openly to reveal his method Bacon coincided with the common feeling of his own and earlier times. In the middle ages no new discovery was freely published. All the secrets, real or pretended, of the alchemists were concealed in obscure and enigmatic language; and to mention a well-known instance, the anagram in which Roger Bacon is supposed to have recorded his knowledge of the art of making gunpowder is so obscure, that its meaning is even now more or less doubtful. In Bacon's own time one of the most remarkable discoveries of Galileo — that of the phases of Venus — was similarly hidden in an anagram,

[1] See Note B. at the end, extract 4th, and the concluding remarks in which I have explained my own view of the kind of reserve which Bacon at this time meditated. — *J. S.*

[2] See the same note, extract 1st. I cannot think it was by "abruptness and obscurity" that he proposed to effect the desired separation of readers either in *Valerius Terminus* or in the *Temporis Partus Masculus.* — *J. S.*

though the veil in this case was more easily seen through. This disposition to conceal scientific discoveries and methods is connected with the views which in the middle ages were formed of the nature of science. To know that which had previously been unknown was then regarded as the result not so much of greater industry or acuteness as of some fortunate accident, or of access to some hidden source of information: it was like finding a concealed treasure, of which the value would be decreased if others were allowed to share in it. Moreover the love of the marvellous inclined men to believe in the existence of wonderful secrets handed down by tradition from former ages, and any new discovery acquired something of the same mysterious interest by being kept back from the knowledge of the vulgar. Other causes, which need not here be detailed, increased this kind of reserve; such as the dread of the imputation of unlawful knowledge, the facility which it gave to deception and imposture, and the like.

The manner in which Bacon proposed at one time to perpetuate the knowledge of his method is also in accordance with the spirit of the middle ages. In the writings of the alchemists we meet continually with stories of secrets transmitted by their possessor to one or more disciples. Thus Artefius records the conversation wherein his master, Boemund, transmitted to him the first principles of all knowledge; and it is remarkable that in this and similar cases the disciple is called "mi fili" by his instructor — a circumstance which shows from what source Bacon derived the phrase "ad filios," which appears in the titles of several of his early pieces. Even in the *De Augmentis*

the highest and most effectual form of scientific teaching is called the "methodus ad filios."[1]

When he wrote the *Cogitata et Visa*, Bacon seems to have perceived[2] how much of vanity and imposture had always been mixed up with this affectation of concealment and reserve. "Reperit autem," he there says, "homines in rerum scientiâ quam sibi videntur adepti, interdum proferendâ interdum occultandâ, famæ

[1] Lib. vi. c. 2. I cannot think however that the merit of this method had anything to do with *secresy*. For the distinctive object of it is stated to be the "continuatio et ulterior progressus" of knowledge; and its distinctive characteristic, the being "solito *apertior*." Its aim was to transfer knowledge into the mind of the disciple in the same form in which it grew in the teacher's mind, like a plant with its roots on, that it might continue to grow. Its other name is "traditio lampadis," alluding to the Greek torch-race; which was run, as I understand it, not between individuals, but between what we call *sides*. Each side had a lighted torch; they were so arranged that each bearer, as he began to slacken, handed it to another who was fresh; and the side whose torch first reached the goal, still a-light, was the winner. The term "filii," therefore, alludes, I think, to the successive generations, not who should inherit the secret, but who should carry on the work. Compare the remarks in the *Sapientia Veterum* (Fab. xxvi. near the end,) upon the torch-races in honour of Prometheus. "Atque continet in se monitum, idque prudentissimum, ut perfectio scientiarum a successione, non ab unius alicujus pernicitate aut facultate, expectetur. . . . . Atque optandum esset ut isti ludi in honorem Promethei, sive humanæ naturæ, instaurarentur, atque res *certamen*, *et æmulationem*, *et bonam fortunam* reciperet; neque ex unius cujuspiam face tremulâ atque agitatâ penderet." To me, I must confess, the explanation above given of Bacon's motives for desiring a select audience seems irreconcilable both with the objects which he certainly had in view and with the spirit in which he appears to have pursued them. "Fit audience, though few," he no doubt desired; and I can easily believe that he wished not only to find the fit, but also to exclude the unfit. But the question is, whether his motive in so selecting and so limiting his audience was unwillingness to part with his treasure, or solicitude for the furtherance of his work. To decide this question I have brought together all the passages in which he speaks of the "singling and adopting" of the "fit and legitimate reader." But the collection, with the remarks which it suggests, being too long for a foot-note, I have placed them at the end of this preface. See Note B. — *J. S.*

[2] See Note B., extract 7th. But observe that in the 1st, 3rd, and 4th, he shows himself quite as sensible of the vanity and imposture which such secresy had been made to subserve. — *J. S.*

et ostentationi servire; quin et eos potissimum qui minus solida proponunt, solere ea quæ afferunt obscurâ et ambiguâ luce venditare, ut facilius vanitati suæ velificare possint." The matter which he has in hand, he goes on to say, is one which it were nowise fitting to defile by affectation or vain glory; but yet it cannot be forgotten that inveterate errors, like the delusions of madmen, are to be overcome by art and subtlety, and are always exasperated by violence and opposition. The result of this kind of dilemma is that the method is to be propounded in an example, — a decision in which it is probable that he was still more or less influenced by the example of those whom he here condemns.

Thus much of the connexion between the plan of the *Novum Organum* and that which Bacon laid down in the *Cogitata et Visa*. That there is no didactic exposition of his method in the whole of his writings has not been sufficiently remarked by those who have spoken of his philosophy; probably because what he himself regarded as a sort of exoteric doctrine, namely the views of science contained in the first book of the *Novum Organum*, have received much more attention than the method itself, which is nevertheless the cardinal point of his whole system. Bacon is to be regarded, not as the founder of a new philosophy, but as the discoverer of a new method; at least we must remember that this was his own view of himself and of his writings.

I proceed to give some account of the structure of the *Novum Organum* and of the parts into which it may be most conveniently divided.

After the preface, in which Bacon professes that it is

not his intention to destroy the received philosophy, but rather that from henceforth there should be two coexisting and allied systems, — the one sufficient for the ordinary purposes of life, and such as would satisfy those who are content with probable opinions and commonly received notions; the other for the sons of science, who desire to attain to certainty and to an insight into the hidden things of Nature, — we come to the *Novum Organum* itself; which commences with some weighty sentences concerning the relation of Man to Nature. The first aphorism, perhaps the most often quoted sentence in the *Novum Organum*, occurs twice in the fragments published by Gruter; namely in the *Aphorismi et Consilia de Auxiliis Mentis*, and again in a less perfect form in the *De Interpretatione Naturæ Sententiæ* XII., both which fragments are included [by M. Bouillet] [1] under the title *Temporis Partus Masculus*, though they are clearly of different dates. The wording of the aphorism in the former is almost precisely the same as in the *Novum Organum*. In all three places man is styled "naturæ minister et interpres." He is naturæ interpres, because in every object which is presented to him there are two things to be considered, or rather two aspects of the same thing, — one the phenomenon which Nature presents to the senses — the other the inward mechanism and action, of which the phenomenon in question is not only the result but also the outward sign. To pass therefore from the phenomenon to its hidden cause is to interpret the signs which enable us to become acquainted with the operations of Nature. Again, he is the minister naturæ, because in all his works he can

[1] Not so included by *Gruter*. See note A. at the end, § 3. — *J. S.*

only arrange the things with which he deals in the order and form which Nature requires. All the rest comes from her only; the conditions she requires having been fulfilled, she produces new phenomena according to the laws of her own action. Thus the two words *minister* and *interpres* refer respectively to works and contemplation — to power and knowledge — the substance of Bacon's theory of both being compressed into a single phrase. The third and fourth aphorisms are developments of the first; the second relating not to the theory of knowledge, but to the necessity of providing helps for the understanding.

Then follow (5—10.) reflections on the sterility of the existing sciences, and (11—17.) remarks on the inutility of logic. In (14.) Bacon asserts that everything must depend on a just method of induction. From (18.) to (37.) he contrasts the only two ways in which knowledge can be sought for; namely anticipations of Nature and the interpretation of Nature. In the former method men pass at once from particulars to the highest generalities, and thence deduce all intermediate propositions; in the latter they rise by gradual induction and successively, from particulars to axioms of the lowest generality, then to intermediate axioms, and so ultimately to the highest. And this is the true way, but as yet untried.

Then from (38.) to (68.) Bacon developes the doctrine of idols. It is to be remarked that he uses the word idolon in antithesis to idea, the first place where it occurs being the twenty-third aphorism. "Non leve quiddam interest," it is there said, "inter humanæ mentis idola et divinæ mentis ideas." He nowhere refers to the common meaning of the word,

namely the image of a false god. Idols are with him "placita quædam inania," or more generally, the false notions which have taken possession of men's minds. The doctrine of idols stands [he says] in the same relation to the interpretation of Nature, as the doctrine of fallacies to ordinary logic.

Of idols Bacon enumerates four kinds, — the idols of the tribe, of the cave, of the market-place, and of the theatre; and it has been supposed that this classification is borrowed from Roger Bacon, who in the beginning of the *Opus Majus* speaks of four hindrances whereby men are kept back from the attainment of true knowledge. But this supposition is for several reasons improbable. The *Opus Majus* was not printed until the eighteenth century, and it is unlikely that Francis Bacon would have taken the trouble of reading it, or any part of it, in manuscript.[1] In the first place there is no evidence in any part of his works of this kind of research, and in the second he had no high opinion of his namesake, of whom he has spoken with far less respect than he deserves. The only work of Roger Bacon's which there is any good reason for believing that he was acquainted with is a tract on the art of prolonging life, which was published at Paris in 1542, and of which an English translation appeared in 1617. The general resem

[1] I can hardly think that he would have omitted to look into a work like the *Opus Majus*, if he had had the opportunity. But it is very probable that no copy of it was procurable; possible that he did not even know of its existence. The manner in which he speaks of Roger Bacon in the *Temporis Partus Masculus*, as belonging to the "utile genus" of experimentalists, "qui de theoriis non admodum soliciti *mechanicâ quâdam subtilitate rerum inventarum extensiones prehendunt*," seems rather to imply that he knew of him at that time chiefly by his reputation for mechanical inventions. — *J. S.*

blance between the spirit in which the two Bacons speak of science and of its improvement is, notwithstanding what has sometimes been said, but slight. Both no doubt complain that sufficient attention has not been paid to observation and experiment, but that is all; and these complaints may be found in the writings of many other men, especially in the time of Francis Bacon. Nothing is more clear than that the essential doctrines of his philosophy — among which that of idols is to be reckoned — are, so far as he was aware, altogether his own. There is moreover but little analogy between his idols and his namesake's hindrances to knowledge. The principle of classification is altogether different, and the notion of a real connexion between the two was probably suggested simply by there being the same number of idols as of hindrances.[1] It is therefore well to remark that in the early form of the doctrine of idols there were only three. In the *Partis secundæ Delineatio* the idols wherewith the mind is beset are said to be of three kinds: they either are inherent and innate or adscititious; and if the latter, arise either from received opinions in philosophy or from wrong principles of demonstration. This classification occurs also in *Valerius Terminus*.[2]

[1] That the two may be the more conveniently compared, I have quoted Roger Bacon's exposition of his "offendicula," in a note upon the 39th aphorism, in which the names of the four "Idols" first occur. How slight the resemblance is between the two may be ascertained by a very simple test. If you are already acquainted with Francis Bacon's classification, try to assign each of the "offendicula" to its proper class. If not, try by the help of Roger's classification to find out Francis's. — *J. S.*

[2] Not in *Valerius Terminus*. It occurs in the *Distributio Operis*, and may be traced though less distinctly in the *Advancement* and the *De Augmentis*. See Note C. at the end. — *J. S.*

The first of these three classes corresponds to the first and second of those spoken of in the *Novum Organum*. The idols of the tribe are those which belong, as Aristotle might have said, to the human mind as it is human, — the erroneous tendencies common more or less to all mankind. The idols of the cave arise from each man's mental constitution: the metaphor being suggested by a passage in the [opening of the seventh book of Plato's *Republic*.][1] Both classes of extraneous idols mentioned in the *Partis secundæ Delineatio* are included in the idola theatri, and the idola fori correspond to nothing in the earlier classification.[2] They also are extraneous idols, but result neither from received opinions nor erroneous forms of demonstration, but from the influence which words of necessity exert. They are called idols of the market-place because they are caused by the daily intercourse of common life. "Verba," remarks Bacon, "ex captu vulgi imponuntur."

It is only when we compare the later with the earlier form of the doctrine of idols that we perceive the principle of classification which Bacon was guided by, namely the division of idols according as they come from the mind itself or from without.[3] In the *Novum Organum* two belong to the former class and two to

[1] Mr. Ellis had written "in the of Aristotle." But the words of the *De Augmentis* (v. 4.) ("de specu *Platonis*") prove that it was the passage in Plato which suggested the metaphor. — *J. S.*

[2] i. e. in the classification adopted in the *Partis secundæ Delineatio;* for they correspond exactly with the third kind of fallacies or false appearances mentioned in the *Advancement*, and with the idols of the palace in *Valerius Terminus*. And I think they were meant to be included among the "Inhærentia et Innata" of the *Delineatio*. See Note C. — *J. S.*

[3] Rather, I think, as they are separable or inseparable from our nature and condition in life. See Note C. — *J. S.*

the latter, so that the members of the classification are better balanced[1] than in the previous arrangement: in both perhaps we perceive a trace of the dichotomizing principle of Ramus, one of the seeming novelties which he succeeded in making popular.[2]

After enumerating the four kinds of idols, Bacon gives instances of each (45—67.); and speaking in (62.) of idols of the theatre, introduces a triple classification of false philosophies, to which he seems to have attached much importance, as we find it referred to in many parts of his writings. False philosophy is sophistical, empirical, or superstitious; sophistical, when it consists of dialectic subtleties built upon no better foundation than common notions and every-day observation; empirical, when it is educed out of a few experiments, however accurately examined; and superstitious, when theological traditions are made its basis. In the *Cogitata et Visa* he compares the rational philosophers (that is, those whose system is sophistical, — the name implying that they trust too much to reason and despise observation) to spiders whose webs are spun out of their own bodies, and the empirics to the ant which simply lays up its store and uses it. Whereas the true way is that of the bee, which gathers its materials from the flowers of the field and of the garden, and then, ex propriâ facultate, elaborates and transforms them.[3] The third kind of

[1] Compare the Distributio Operis, where the classification is retained, with the *Novum Organum*, where it is not alluded to, and I think it will be seen that Bacon did not intend to balance the members in this way. See Note C. at the end. — *J. S.*

[2] Bacon alludes to Ramus in the *De Augmentis* vi. 2., "De unicâ methodo et dichotomiis perpetuis nil attinet dicere. Fuit enim nubecula quædam doctrinæ quæ cito transiit: res certe simul et scientiis damnosissima," &c.

[3] In the *Advancement of Learning* and the *De Augmentis*, the schoolmen

false philosophy is not here mentioned. In the *Novum Organum* Bacon perhaps intended particularly to refer to the Mosaical philosophy of Fludd, who is one of the most learned of the Cabalistic writers.[1]

In (69.) Bacon speaks of faulty demonstrations as the defences and bulwarks of idols, and divides the common process for the establishment of axioms and conclusions into four parts, each of which is defective. He here describes in general terms the new method of induction. In the next aphorism, which concludes this part of his subject, he condemns the way in which experimental researches have commonly been carried on.

The doctrine of idols seems, when the *Novum Organum* was published, to have been esteemed one of its most important portions. Mersenne at least, the earliest critic on Bacon's writings, his *Certitude des Sciences* having been published in 1625,[2] speaks of the four idols, or rather of Bacon's remarks upon them, as the four buttresses of his philosophy. In Bacon's own opinion this doctrine was of much importance. Thus in the *De Interpretatione Naturæ Sententiæ Duodecim* he says, in the abrupt style of his earlier philosophical writings, "Qui primum et

in particular are compared to the spider; a passage which has been misunderstood by a distinguished writer, whose judgments seem not unfrequently to be as hastily formed as they are fluently expressed, and who conceives that Bacon intended to condemn the study of psychology.

In speaking of the field and the garden, Bacon refers respectively to observations of Nature and artificial experiment; an instance of the "curiosa felicitas" of his metaphors.

[1] Fludd's work, entitled *Philosophia Moysaica*, was published in 1638.

[2] In the *Biographie Universelle* (Mersenne) it is incorrectly said that this work was published in 1636, and an idle story is mentioned that it was in reality written, not by Mersenne, but by Lord Herbert of Cherbury, — a story sufficiently refuted by its scrupulous and submissive orthodoxy.

ante alia omnia animi motus humani penitus non explorarit, ibique scientiæ meatus et errorum sedes accuratissime descriptas non habuerit, is omnia larvata et veluti incantata reperiet; fascinum ni solverit interpretari non poterit.[1]

From (71.) to (78.) he speaks of the signs and tokens whereby the defects and worthlessness of the received sciences are made manifest. The origin of these sciences, the scanty fruits they have borne, the little progress they have made, all testify against them; as likewise the confessions of the authors who have treated of them, and even the general consent with which they have been received. "Pessimum," says Bacon, "omnium est augurium, quod ex consensu capitur in rebus intellectualibus."[2]

From (78.) to (92.) Bacon speaks of the causes of the errors which have hindered the progress of science; intending thereby to show that there is no reason to doubt the value of the reform which he is about to propose, because though in itself seemingly plain and obvious it has nevertheless remained so long unthought of. On the contrary, there is, he affirms, good reason for being surprised that even now any one should have thought of it.

The first of these causes is the comparative shortness of the periods which, out of the twenty-five centuries which intervene between Thales and Bacon's own

[1] So also in the *Valerius Terminus*, c. 17.: "That if any have had or shall have the power and resolution to fortify and inclose his mind against all anticipations, yet if he have not been or shall not be cautioned by the full understanding of the nature of the mind and spirit of man, and therein of the seats, pores, and passages both of knowledge and error, he hath not been, nor shall not be, possibly able to guide or keep on his course aright." —*J. S.*

[2] He however excepts matters political and religious.

time, have been really favourable to the progress of science. The second, that even during the more favourable times natural philosophy, the great mother of the sciences, has been for the most part neglected; men having of late chiefly busied themselves with theology, and among the Greeks and Romans with moral philosophy, "quæ ethnicis vice theologiæ erat." Moreover, even when men occupied themselves the most with natural philosophy (Bacon refers to the age of the early Greek physicists), much time was wasted through controversies and vain glory. Again, even those who have bestowed pains upon natural philosophy have seldom, especially in these latter times, given themselves wholly up to it. Thus, natural philosophy having been neglected and the sciences thereby severed from their root, it is no wonder that their growth has been stopped.

Another cause of their scanty progress is, that their true end, the benefit and relief of man's estate, has not been had in remembrance. This error Bacon speaks of in the *Advancement* as the greatest of all, coupling however there with the relief of man's estate the glory of the Creator. Again, the right path for the advancement of knowledge has not only been neglected but blocked up, men having come not only to neglect experience but also to despise it. Also the reverence for antiquity has hindered progress; and here Bacon repeats the remark he had made in the *Advancement*, that antiquity was the world's youth, and the latter times its age.[1]

[1] This remark is in itself not new; we read, for instance, in the book of Esdras, that the world has lost its youth, and that the times begin to wax old. Nor is it new in the application here made of it. Probably several writers in the age which preceded Bacon's had already made it, for in that

Again, the progress of science has been hindered by too much respect for what has been already accomplished. And this has been increased by the appearance of completeness which systematic writers on science have given to their works, and also by the vain and boastful promises of some who have pretended to reform philosophy. Another reason why more has not been accomplished, is that so little has been attempted.

To these hindrances Bacon adds three others, — superstitious bigotry, the constitution of schools, universities, and colleges, and the lack of encouragement; and then concludes this part of the subject with that which he affirms to have been the greatest obstacle of all, namely despair of the possibility of progress. To remove this, he goes on to state the grounds of hope for the future,—a discussion which extends from (93.) to (115.).

"Principium autem," he begins, "sumendum a Deo;" that is to say, the excellence of the end proposed is in itself an indication that the matter in hand is from God, nor is the prophecy of Daniel concerning the latter times to be omitted, namely that many shall go to and fro and knowledge shall be increased. Again, the errors committed in time past are a reason

age men were no longer willing to submit to the authority of antiquity, and still felt bound to justify their dissent. Two writers may at any rate be mentioned by whom the thought is as distinctly expressed as by Bacon, namely Giordano Bruno and Otto Casmann; the former in the *Cena di Cenere*, the latter in the preface to his *Problemata Marina*, which was published in 1596, and therefore a few years later than the *Cena*, with which however it is not likely that Casmann was acquainted. Few writers of celebrity comparable to Bruno's appear to have been so little read.

I have quoted both passages in a note on the corresponding passage in [the first book of] the *De Augmentis:* that in the *Cena di Cenere* was first noticed by Dr. Whewell. See his *Philosophy of the Inductive Sciences*, ii. 198.

for hoping better things in the time to come. He therefore sets forth these errors at some length (95—107.). This enumeration begins with the passage already mentioned [as occurring in the *Cogitata et Visa*], in which the true method is spoken of as intermediate to those of the dogmatici or rationales, and of the empirici. There will be, he concludes, good ground for hope when the experimental and reasoning faculties are more intimately united than they have ever yet been. So likewise when natural philosophy ceases to be alloyed with matter extraneous to it, and when any one can be found content to begin at the beginning and, putting aside all popularly received notions and opinions, to apply himself afresh to experience and particulars. And here Bacon introduces an illustration which he has also employed elsewhere, comparing the regeneration of the sciences to the exploits of Alexander, which were at first esteemed portentous and more than human, and yet afterwards it was Livy's judgment that he had done no more than despise a vain show of difficulty. Bacon then resumes his enumeration of the improvements which are to be made, each of which will be a ground of hope. The first is a better natural history than has yet been composed; and it is to be observed that a natural history which is designed to contain the materials for the instauration of philosophy differs essentially from a natural history which has no such ulterior end: the chief difference is, that an ordinary natural history does not contain the experimental results furnished by the arts. In the second place, among these results themselves there is a great lack of experimenta lucifera, that is of experiments which, though not practically useful, yet serve

to give light for the discovery of causes and axioms: hitherto men have busied themselves for the most part with experimenta fructifera, that is experiments of use and profit. Thirdly, experimental researches must be conducted orderly and according to rule and law, and not as hitherto in a desultory and irregular manner. Again, when the materials required have been collected, the mind will not be able to deal with them without assistance and memoriter: all discoveries ought to be based upon written records — "nulla nisi de scripto inventio probanda est." This is what Bacon calls experientia litterata,[1] his meaning apparently being that out of the storehouse of natural history all the facts connected with any proposed subject of investigation should be extracted and reduced to writing before anything else is done. Furthermore, all these facts must not only be reduced to writing, but arranged tabularly. In dealing with facts thus collected and arranged, we are to regard them chiefly as the materials for the construction of axioms, our path leading us upwards from particulars to axioms, and then downwards from axioms to works; and the ascent from particulars to axioms must be gradual, that is axioms of a less degree of generality must always be established before axioms of a higher. Again a new form of induction is to be introduced; for induction by simple

[1] "Illâ vero in usum veniente, ab experientiâ *factâ demum literatâ*, melius sperandum." In Montagu's edition *literatâ* is printed incorrectly with a capital letter; which makes it seem as if the *experientia facta literata* here spoken of were the same as the *experientia quam vocamus literatam* in Aph. 103. But they are, in fact, two different things; the one being opposed to experience which proceeds without any written record of its results; the other to *vaga experientia et se tantum sequens* — experience which proceeds without any method in its inquiries. See my note on Aph. 101 [Complete Works, I. 310]. — *J. S.*

enumeration is childish and precarious. But true induction analyses nature by rejections and exclusions, and concludes affirmatively after a sufficient number of negatives. And our greatest hope rests upon this way of induction. Also the axioms thus established are tc be examined whether they are of wider generality than the particulars employed in their construction, and if so, to be verified by comparing them with other facts, "per novorum particularium designationem,[1] quasi fide-jussione quâdam." Lastly, the sciences must be kept in connexion with natural philosophy.

Bacon then goes on (108—114.) to state divers grounds of hope derived from other sources than those of which he has been speaking, namely, the errors hitherto committed. The first is that without any method of invention men have made certain notable discoveries; how many more, then, and greater, by the method now to be proposed. Again, of discoveries already made, there are many which before they were made would never have been conceived of as possible, which is a reason for thinking that many other things still remain to be found out of a nature wholly unlike any hitherto known. In the course of ages these too would doubtless some time or other come to light; but by a regular method of discovery they will be made known far more certainly and in far less time, — *propere et subito et simul.* Bacon mentions particularly, as discoveries not likely to have been thought of beforehand, gunpowder, silk, and the mariner's compass; remarking that if the conditions to be fulfilled had been

[1] I understand *designatio* here to mean *discovery.* The test of the truth of the axiom was to be the discovery by its light of *new* particulars. See *Valerius Terminus,* ch. xii., quoted in note on Aph. 106 [Complete Works, I. 113]. — *J. S.*

stated, men would have sought for something far more akin than the reality to things previously known: in the case of gunpowder, if its effects only had been described, they would have thought of some modification of the battering-ram or the catapult, and not of an expansive vapour; and so in the other cases. He also mentions the art of printing as an invention perfectly simple when once made, and which nevertheless was only made after a long course of ages. Again, we may gain hope from seeing what an infinity of pains and labour men have bestowed on far less matters than that now in hand, of which if only a portion were given to the advancement of sound and real knowledge, all difficulties might be overcome. This remark Bacon makes with reference to his natural and experimental history, which he admits will be a great and royal work, and of much labour and cost. But the number of particulars to be observed ought not to deter us; on the contrary, if we consider how much smaller it is than that of the figments of the understanding, we shall find even in this grounds for hope. To these figments, commenta ingenii, the phænomena of Nature and the arts are but a mere handful. Some hope too, Bacon thinks, may be derived from his own example; for if, though of weak health, and greatly hindered by other occupations, and moreover in this matter altogether "protopirus" and following no man's track nor even communicating these things with any, he has been able somewhat to advance therein, how much may not be hoped for from the conjoined and successive labours of men at leisure from all other business? Lastly, though the breeze of hope from that new world were fainter than it is, still it were worth while to follow the ad-

venture, seeing how great a reward success would bring.

And here (115), Bacon says, concludes the pulling-down part, pars destruens, of the Instauration. It consists of three confutations; namely, of the natural working of the mind, of received methods of demonstration, and of received theories or philosophies. In this division we perceive the influence of the first form of the doctrine of Idols. As the *Novum Organum* now stands, the pars destruens cannot be divided into three portions, each containing one of the confutations just mentioned. Thus, for instance, the doctrine of Idols, which undoubtedly forms a distinct section of the whole work, relates to all three. Errors natural to the mind, errors of demonstration, errors of theory, are all therein treated of; and Bacon then goes on to another part of the subject, in which, though from a different point of view, they are all again considered. The sort of cross division here introduced is explained by a passage in the *Partis secundæ Delineatio*, in which the doctrine of Idols is introduced by the remark, "Pars destruens triplex est secundum triplicem naturam idolorum quæ mentem obsident." And then, after dividing idols into the three classes already mentioned, he proceeds thus: — "Itaque pars ista quam destruentem appellamus tribus redargutionibus absolvitur, redargutione philosophiarum, redargutione demonstrationum, et redargutione rationis humanæ nativæ." When the doctrine of Idols was thrown into its present form it ceased to afford a convenient basis for the pars destruens; and accordingly the substance of the three redargutiones is in the *Novum Organum* less systematically set forth

than Bacon purposed that it should be when he wrote the *Partis secundæ Delineatio*.[1] It is to be remarked that *Redargutio Philosophiarum* is the title of one of the chapters in the third and last of the tracts published by Gruter with the title *Temporis Partus Masculus*,[2] and that it is also the title of a tract published [by Stephens in 1734, and reprinted] by Mallet [in 1760[3]], and evidently of a later date than the other of the same name.

From (116) to (128) Bacon endeavours to obviate objections and unfavourable opinions of his design. In the first place he plainly declares that he is no founder of a sect or school, — therein differing from the ancient Greeks, and from certain new men, namely Telesius, Patricius, and Severinus. Abstract opinions

[1] I think this apparent discrepancy may be better explained. It appears to me that the number of idols was originally three, — the Tribe, the Cave, and the Market-place; all belonging to the *ratio humana nativa;* fallacies innate or inherent in the human understanding, — to be guarded against, but not to be got rid of; and that a fourth was added afterwards, but of quite a different kind; consisting of fallacies which have no natural affinity to the understanding, but come from without and may be turned out again; impressions derived from the systems which men have been taught to accept as true, or from the methods of demonstration which they have been taught to rely upon as conclusive. These are the Idols of the Theatre, and the sole objects of the two Redargutiones which stand first in the *Delineatio*, and last in the *Novum Organum*. If this be true, the *Redargutio rationis humanæ nativæ* (or I should rather say, the part of the *Novum Organum* which belongs to it) extends from the 40th to the 60th aphorism; and the *Redargutio Philosophiarum* and *Demonstrationum* from the 61st to the 115th. For a fuller explanation and justification of this view, see Note C. — *J. S.*

[2] Say rather, "is the title prefixed by M. Bouillet to the second chapter of the fragment printed by Gruter with the heading *Tradendi modus legitimus.*" I cannot find that M. Bouillet had any authority for giving it this title, more than the tenor of the chapter itself, which shows that it fits. — *J. S.*

[3] A small portion of it was printed by Gruter at the end of the *Partis secundæ Delineatio* [and it seems to have been the beginning of the *Pars secunda* itself].

on nature and first principles are in his judgment of no great moment. Nor again does he promise to mankind the power of accomplishing any particular or special works — for with him works are not derived from works nor experiments from experiments, but causes and axioms are derived from both, and from these new works and experiments are ultimately deduced; and at present the natural history of which he is in possession is not sufficient for the purposes of legitimate interpretation, that is, for the establishment of axioms. Again, that his *Natural History* and *Tables of Invention* are not free from errors, which at first they cannot be, is not a matter of much importance. These errors, if not too numerous, will readily be corrected when causes and axioms have been discovered, just as errors in a manuscript or printed book are easily corrected by the meaning of the passage in which they occur. Again, it may be said that the *Natural History* contains many commonplace things; also many things mean and sordid; and lastly many things too subtle to be of any use. To this a threefold answer is to be given. In the first place, rare and notable things cannot be understood, much less new things brought to light, unless the causes of common things and their causes' causes be duly examined and searched out. Secondly, whatever is worthy of existence is also worthy to be known; for knowledge represents and is the image of existence. Lastly, things apparently useless are in truth of the greatest use. No one will deny that light is useful, though it is not tangible or material. And the accurate knowledge of simple natures is as light, and gives access to all the secrets on which

works depend, though in itself it is of no great use.

Again it may be thought a hard saying that all sciences and authors are at once to be set aside together. But in reality this is both a more modest censure and one that carries with it a greater show of reason than any partial condemnation. It implies only that the errors hitherto committed are fundamental, and that they have not been corrected because as yet they have not been sufficiently examined. It is no presumption if any man asserts that he can draw a circle more truly with a pair of compasses than another can without; and the new method puts men's understandings nearly on the same level, because everything is to be done by definite rules and demonstrations. Bacon anticipates also another objection, that he has not assigned to the sciences their true and highest aim; which is the contemplation of truth, — not works, however great or useful. He affirms that he values works more inasmuch as they are signs and evidences of truth than for their practical utility. It may also, he continues, be alleged that the method of the ancients was in reality the same as ours, only that after they had constructed the edifice of the sciences they took away the scaffolding. But this is refuted both by what they themselves say of their method,[1] and by what is seen of it in their writings. Again he affirms that he does not inculcate, as some might suppose, a[2] [final suspension of judgment, as if the

[1] I have adopted here the correctior introduced into the text of the present edition.

[2] Mr. Ellis had written thus far when the fever seized him. The remaining pages which complete the analysis of the first book, are mine. — *J. S.*

mind were incapable of knowing anything; that if he enjoins caution and suspense it is not as doubting the competency of the senses and understanding, but for their better information and guidance; that the method of induction which he proposes is applicable not only to what is called natural philosophy, as distinguished from logic, ethics, and politics, but to every department of knowledge; the aim being to obtain an insight into the nature of things by processes varied according to the conditions of the subject; and that in declaring that no great progress can be expected either in knowledge of truth or in power of operation by the methods of inquiry hitherto employed, he means no disrespect to the received arts and sciences, but fully recognises them as excellent in their proper place and use, and would have them honoured and cultivated accordingly.

These explanations, — together with some remarks (129), by way of encouragement to followers and fellow-labourers, on the dignity, importance, and grandeur of the end in view, — bring the preliminary considerations to a close, and clear the way for the exposition of the art of interpretation itself; which is commenced, but not completed, in the second book. What this art was, has been fully discussed in the general preface, and it is not necessary therefore to follow the subject further here. Only it is important to remark that whatever value Bacon may have attached to it, he certainly did not at this time profess to consider it either as a thing absolutely necessary, or even as the thing most necessary, for any real progress in science. In the concluding aphorism of the first book he distinctly warns the reader that the precepts which he is about

to give, though he believes them to be very useful and sound, and likely to prove a great help, are not offered either as perfect in themselves or as so indispensable that nothing can be done without them. Three things only he represents as indispensable: 1st, ut "justam naturæ et experientiæ historiam præsto haberent homines atque in eâ sedulo versarentur;" 2nd, "ut receptas opiniones et notiones deponerent;" 3rd, "ut mentem a generalissimis et proximis ab illis ad tempus cohiberent." These three conditions being secured, the art of interpretation (being indeed the true and natural operation of the mind when freed from impediments) might, he thinks, suggest itself without a teacher: "fore ut etiam vi propriâ et genuinâ mentis, absque aliâ arte, in formam nostram interpretandi incidere possent; est enim interpretatio verum et naturale opus mentis, demptis iis quæ obstant:" an admission which helps to account for the fact that during the five years which he afterwards devoted to the developement of his philosophy, he applied himself almost exclusively to the natural history; leaving the exposition of his method of interpretation still incomplete. For it cannot be denied that, among the many things which remained to be done, the setting forward of the *Natural History* was, according to this view, the one which stood next in order of importance. In furtherance of the two other principal requisites, he had already done what he could. Every motive by which men could be encouraged to lay prejudices aside, and refrain from premature generalisations, and apply themselves to the sincere study of Nature, had already been laid before them. It remained to be seen whether his exhortations would bring other labourers into the field; but in the mean time the question lay between

the completion of the *Novum Organum*, which was not indispensable, and the commencement of the collection of a *Natural History*, which was; and when he found that other labourers did *not* come forward to help, he naturally applied himself to the latter.]

NOTES

Note A.

I thought it better not to interrupt the reader with notes during the progress of the foregoing argument, but as some points are assumed in it upon which I shall have to express a different opinion hereafter, it may be well to notice them here; the rather because I fully concur in the conclusion notwithstanding.

1. It is assumed that the first book of *Valerius Terminus* was designed to comprehend a general survey of knowledge, such as forms the subject of the second book of the *Advancement of Learning* and of the last eight books of the *De Augmentis Scientiarum*, as well as the general reflexions and precepts, which form the subject of the first book of the *Novum Organum;* — to comprehend in short the whole first part of the Instauratio, together with the introductory portion of the second.

This is inferred from the description of the "Inventary" which was to be contained in the tenth chapter of *Valerius Terminus*, as compared with the contents of the second book of the *Advancement of Learning.*

Now my impression is that this Inventary would have corresponded, not to the second book of the *Advancement*, but only to a certain *Inventarium opum humanarum* which is there, and also in the *De Augmentis* (iii. 5), set down as a *desideratum;* and which was to be, not a general survey of all the departments of knowledge, but merely an appendix to one particular department; that, namely, which is called in the *Advancement Naturalis Magia, sive Physica operativa major;*[1] and in the *Catalogus De-*

[1] See margin. It is to be observed that in Montagu's edition of the *Advancement* the titles in the margin are by some strange negligence omitted; so that the correspondence between the two Inventaries was the more easily overlooked.

sideratorum at the end of the *De Augmentis*, *Magia Naturalis, sive Deductio formarum ad opera.*

The grounds of this conclusion will be explained fully in their proper place.[1] It is enough at present to mark the point as disputable; and to observe that if this argument fails, there seems to be no reason for thinking that anything corresponding to the *first* part of the Instauratio entered into the design of *Valerius Terminus;* also that the principal ground here alleged for concluding that *Valerius Terminus* was written some time before the *Advancement* — a conclusion which involves one considerable difficulty — is taken away.

2. It is assumed also that *Valerius Terminus* was *not* to contain anything corresponding to the last four parts of the Instauratio, but was to be merely "a statement of Bacon's method, without professing to give either the collection of facts to which the method was to be applied, or the results thereby obtained."

This appears to be inferred chiefly from the title — viz. "Of the Interpretation of Nature."

Now it seems to me that this argument proves too much. For I find the same title given to another unfinished work — the *Temporis Partus Masculus* — of which we happen to know that it was meant to be in three books; the first to be entitled *Perpolitio et applicatio mentis;* the second, *Lumen Naturæ, seu formula Interpretationis;* the third, *Natura illuminata, sive Veritas Rerum.* The first would have corresponded therefore to the first book of the *Novum Organum;* the second, being a statement of the new method, to the second and remaining books; the third, being a statement of the application of the new method, to the sixth and last part of the Instauratio. It would seem from this that when Bacon designed the *Temporis Partus Masculus*, he had conceived the idea of a work embracing the entire field of the Instauratio, (the first part only excepted), though less fully developed and differently distributed. And I see no sufficient reason for supposing that the design of the *Valerius Terminus* was less extensive.

3. "The *Temporis Partus Masculus* published by Gruter" is spoken of as probably or possibly "the same as the *Temporis Partus Maximus* mentioned by Bacon in his letter to Fulgenzio," and if so, the earliest of all his writings.

[1] See my note at the end of Mr. Ellis's preface to *Valerius Terminus.*

Now the writing or rather collection of writings here alluded to is that published not by Gruter but by M. Bouillet; in whose edition of the "Œuvres Philosophiques" the title *Temporis Partus Masculus* is prefixed to four distinct pieces. 1. A short prayer. 2. A fragment headed *Aphorismi et Consilia de auxiliis mentis et accensione luminis naturalis.* 3. A short piece entitled *De Interpretatione Naturæ sententiæ duodecim.* 4. A fragment in two chapters headed *Tradendi modus legitimus.* It is true that from the manner in which M. Bouillet has printed them, any one would suppose that he had Gruter's authority for collecting them all under the same general title. But it is not so. In Gruter's *Scripta philosophica* the title *Temporis Partus Masculus* appears in connexion with the first, and the first only. The last has indeed an undoubted claim to it upon other and better authority. But I can find no authority whatever for giving it to the other two. If therefore the resemblance of the names be thought a sufficient reason for identifying the *Partus Masculus* with the *Partus Maximus*, that identity must be understood as belonging to the first and fourth only. The grounds of that opinion and of my own dissent from it will be discussed in the proper place. With regard to the argument now in hand,—(viz. whether Bacon, when he wrote the *Temporis Partus Masculus*, had yet thought of producing a great work like the Instauratio)—it is enough perhaps to observe that at whatever period or periods of his life these four pieces were composed, they all belong to the second part of the Instauratio; not as prefaces or prospectuses, but as portions of the work itself; and that if none of them contain any allusion to the other parts, the same may be said of the first book of the *Novum Organum* itself; and therefore that we cannot be warranted in concluding from that fact that the plan of the Instauratio had not yet been conceived.

4. It is assumed that the work which Bacon contemplated when he wrote the *De Interpretatione Naturæ Proœmium* would not have contained the new method and its results (these being, according to his then intention, to be communicated only to chosen followers), but merely the general views of science which form the subject of the first book of the *Novum Organum.*

This seems to be gathered from what he says in the Proœmium concerning the manner in which the several parts of the work were to be published: "Publicandi autem ista ratio ea est, ut quæ

ad ingeniorum correspondentias captandas et mentium areas purgandas pertinent, edantur in vulgus et per ora volitent: *reliqua per manus tradantur cum electione et judicio:*" the "reliqua" being, as appears a little further on, "ipsa Interpretationis formula et inventa per eandem:" from which it seems to be inferred that the exposition of the new method was not only not to be *published* along with the rest of the work, but to be excluded from it altogether; — to be kept as a secret, and transmitted *orally*. The grounds of this opinion I shall examine more particularly in a subsequent note with reference to another question. The question with which we are now dealing is only whether at that time Bacon can be supposed to have "thought of producing a great work like the Instauratio:" upon which I will only say that as an intention not to *publish* does not imply an intention not to *write*, so neither does an intention to write imply an intention to publish. And since there is nothing in the *Partis secundæ Delineatio* from which we can infer that even then he intended to *publish* the whole, I do not see how we can infer that the design of *composing* a great work like the Instauratio had been conceived in the interval between the writing of these two pieces. For as in the one case he may not have intended to publish what we know he did intend to write, so in the other he may have intended to write what we know he did not intend to publish. And indeed though the Proœmium stands in Gruter's volume by itself and we cannot know to which of Bacon's projected works on the Interpretation of Nature it was meant to be prefixed, there is none which it seems to fit so well as the *Temporis Partus Masculus*. Now the *Temporis Partus Masculus*, as we know from the titles of the three books above quoted, *was* to contain both the *formula Interpretationis* and the *inventa per eandem*.

All these points will be considered more at large when I come to state the grounds upon which I have assigned to each tract its place in this edition. In the meantime I am unwilling to let any conclusion of importance appear to rest upon them; and in the present case all inferences which are in any way dependent upon the assumptions which I have noticed as questionable may I think be freely dispensed with. That to bring in a new method of Induction was Bacon's central idea and original design, and that the idea of an *Instauratio Magna* came after, may in the absence of

all evidence to the contrary be safely enough inferred from his own words in the *Advancement of Learning;* where after reporting a deficiency of the first magnitude in that department of knowledge which concerns the invention of sciences, — a deficiency proved by the barrenness and accounted for by the viciousness and incompetency of the *method of induction then in use*, — he adds, "This part of Invention, concerning the Invention of Sciences, I purpose, if God give me leave, hereafter to propound; having digested into two parts; whereof the one I term *Experientia Literata*, and the other *Interpretatio Naturæ;*[1] the former being but a degree and rudiment of the latter. But I will not dwell too long nor speak too great upon a promise." This "Interpretatio Naturæ" can have been nothing else therefore than a new method of induction to supply the place of the vicious and incompetent method then in use; and since among all the reported "deficiencies" this is the only one which he himself proposes to supply, — for of the others he merely gives specimens to make his meaning clear, — we may, I think, safely conclude that this and no other was the great work which he was meditating when he wrote the *Advancement of Learning.* His expressions moreover seem to imply that this work was already begun and in progress; and seeing that the *Valerius Terminus* answers the description both in title and (so far as the first book goes, which is all we know of it) in contents also, why may we not suppose that it was a commencement or a sketch of the very work he speaks of, and that of the fragment which has been preserved part was written before and part after? a supposition probable enough in itself, and by which at least one difficulty, which I shall mention hereafter,[2] is effectually removed.

As an additional reason for thinking that the idea of the Instauratio Magna was of later date than that of a work on the Interpretation of Nature, I may observe that the *name* Instauratio does not occur in any of Bacon's letters earlier than 1609. The earliest of his compositions in which it appears was probably the *Partis Instaurationis secundæ Delineatio et Argumentum;* but of this the date cannot be fixed with any certainty; and as Gruter is our only authority for it, and the word Instauratio appears in the

[1] The corresponding passage in the *De Augmentis* calls it "Interpretatio Naturæ *sive Novum Organum.*"

[2] See my note at the end of Mr. Ellis's Preface to the *Valerius Terminus*

title only, not in the body of the work, we cannot even be sure that it was originally there. If Gruter found a manuscript headed "Partis secundæ Delineatio, &c.," and evidently referring to the parts of the Instauratio Magna, he was likely enough to insert the word silently by way of explanation.

Note B.

The question is, how far, by what means, and with what motive, Bacon at one time wished to keep his system secret.

Let us first compare all the passages in which such an intention appears to be intimated, or such a practice alluded to; taking them in chronological order, as far as our knowledge of the dates of his various writings enables us to do so. These which follow are all that I have been able to find.

1. *Valerius Terminus.* Ch. 18.

"That the discretion anciently observed, though by the precedent of many vain persons and deceivers abused, of publishing part and reserving part to a private succession, and of publishing in such a manner whereby it may not be to the taste or capacity of all, *but shall as it were single and adopt his reader*, is not to be laid aside; both for the avoiding of abuse in the excluded, and the strengthening of affection in the admitted."

And again (Ch. 11.), "To ascend further by scale I do forbear, partly because it would draw on the example to an over-great length, but chiefly because it would open that *which in this work I determine to reserve.*"

2. *Advancement of Learning.*

"And as Alexander Borgia was wont to say of the expedition of the French for Naples, that they came with chalk in their hands to mark up their lodgings, and not with weapons to fight so I like better that entry of truth which cometh peaceably with chalk *to mark up those minds which are capable to lodge and harbour it*, than that which cometh with pugnacity and contention."

3. *Advancement of Learning.*

"Another diversity of method there is, [he is speaking of the different methods of "tradition," i. e. of communicating and transmitting knowledge] which hath some affinity with the former, used in some cases by the discretion of the ancients, but disgraced since by the impostures of many vain persons, who have made it as a false light for their counterfeit merchandises; and that is, *enigmatical* and *disclosed.* The pretence whereof [that is, of the enigmatical method] is to *remove the vulgar capacities* from being admitted to the secrets of knowledges, and to *reserve them to selected auditors*, or wits of such sharpness as can pierce the veil."

4. *Proœmium de Interpretatione Naturæ.*

"Publicandi autem ista ratio ea est, ut quæ ad ingeniorum correspondentias captandas et mentium areas purgandas pertinent, edantur in vulgus et per ora volitent; reliqua *per manus tradantur cum electione et judicio.* Nec me latet usitatum et tritum esse impostorum artificium, ut quædam a vulgo secernant nihilo iis ineptiis quas vulgo propinant meliora. Sed ego sine omni impostura, ex providentiâ sanâ prospicio, ipsam interpretationis formulam et inventa per eandem, *intra legitima et optata ingenia clausa*, vegetiora et munitiora futura."

5. *De Interpretatione Naturæ Sententiæ* XII.
De moribus Interpretis.

"Sit etiam in scientiâ quam adeptus est nec occultandâ nec proferendâ vanus, sed ingenuus et prudens: tradatque inventa non ambitiosè aut malignè, sed modo primum maxime vivaci et vegeto, id est ad injurias temporis munitissimo, et ad scientiam propagandam fortissimo, deinde ad errores pariendos innocentissimo, et ante omnia *qui sibi legitimum lectorem seponat.*"

6. *Temporis Partus Masculus.* C. 1.

"An tu censes cum omnes omnium mentium aditus ac meatus obscurissimis idolis, iisdemque alte hærentibus et inustis, obsessi et obstructi sint, veris Rerum et nativis radiis sinceras et politas areas adesse? Nova invenienda est ratio quâ mentibus obductissimis illabi possimus. Ut enim phreneticorum deliramenta arte et ingenio subvertuntur, vi et contentione efferantur, omnino ita in

hâc universali insaniâ mos gerendus est. Quid? leviores illæ conditiones, quæ ad legitimum scientiæ tradendæ modum pertinent, an tibi tam expeditæ et faciles videntur? ut modus innocens sit; id est nulli prorsus errori ansam et occasionem præbeat? ut vim quandam insitam et innatam habeat tum ad fidem conciliandam, tum ad pellendas injurias temporis, adeo ut scientia ita tradita, veluti planta vivax et vegeta, quotidie serpat et adolescat? ut *idoneum et legitimum sibi lectorem seponat et quasi adoptet?*"

7. *Cogitata et visa.*

"Itaque de re non modo perficiendâ sed et communicandâ et tradendâ (quâ par est curâ) cogitationem suscipiendam esse. Reperit autem homines in rerum scientiâ quam sibi videntur adepti, interdum proferendâ interdum occultandâ, famæ et ostentationi servire: quin et eos potissimum qui minus solida proponunt solere ea quæ adferunt obscurâ et ambiguâ luce venditare, ut facilius vanitati suæ velificare possint. Putare autem se id tractare quod ambitione aliquâ aut affectatione polluere minime dignum sit; sed tamen necessario eo decurrendum esse (nisi forte rerum et animorum valde imperitus esset, et prorsus inexplorato viam inire vellet) ut satis meminerit, inveteratos semper errores, tanquam phreneticorum deliramenta, arte et ingenio subverti, vi et contentione efferari. Itaque prudentiâ et morigeratione quâdam utendum (quanta cum simplicitate et candore conjungi potest) ut contradictiones ante extinguentur quam excitentur. . . . . Venit ei itaque in mentem posse aliquid simplicius proponi, quod *in vulgus non editum*, saltem tamen ad rei tam salutaris abortum arcendum satis fortasse esse possit. Ad hunc finem parare se de naturâ opus quod errores minimâ asperitate destruere, et ad hominum mentes non turbide accedere possit; quod et facilius fore, quod non se pro duce gesturus, sed ex naturâ lucem præbiturus et sparsurus sit, ut duce postea non sit opus."

8. *Redargutio Philosophiarum* (the beginning of the *Pars secunda*, following the *Delineatio.*)

"Omnem violentiam (ut jam ab initio professi sumus) abesse volumus: atque quod Borgia facetè de Caroli octavi expeditione in Italiam dixit; Gallos venisse in manibus cretam tenentes quâ diversoria notarent, non arma quibus perrumperent; similem quoque inventorum nostrorum et rationem et successum animo præ-

cipimus; nimirum ut potius *animos hominum capaces et idoneos reponere et subire possint*, quam contra sentientibus molesta sint."

9. *Novum Organum.* I. 35.

"Dixit Borgia de expeditione Gallorum in Italiam, eos venisse cum cretâ in manibus, ut diversoria notarent, non cum armis, ut perrumperent: Itidem et nostra ratio est; ut doctrina nostra *animos idoneos et capaces subintret;* confutationum enim nullus est usus, ubi de principiis et ipsis notionibus atque etiam de formis demonstrationum dissentimus."

10. *De Augmentis Scientiarum.* VI. 2.

"Sequitur aliud methodi discrimen, priori [methodo ad filios, etc.], intentione affine, reipsâ fere contrarium. Hoc enim habet utraque methodus commune, ut *vulgus auditorum a selectis separet;* illud oppositum, quod prior introducit modum tradendi solito apertiorem; altera, de quâ jam dicemus, occultiorem. Sit igitur discrimen tale, ut altera methodus sit exoterica, altera acroamatica. Etenim quam antiqui adhibuerunt præcipue in edendis libris differentiam, eam nos transferimus ad ipsum modum tradendi. Quin etiam acroamatica ipsa apud veteres in usu fuit, atque prudenter et eum judicio adhibita. At acroamaticum sive ænigmaticum istud dicendi genus posterioribus temporibus dehonestatum est a plurimis, qui eo tanquam lumine ambiguo et fallaci abusi sunt ad merces suas adulterinas extrudendas. Intentio autem ejus ea esse videtur, *ut traditionis involucris vulgus (profanum scilicet) a secretis scientiarum summoveatur; atque illi tantum admittantur qui aut per manus magistrorum parabolarum interpretationem nacti sunt, aut proprio ingenii acumine et subtilitate intra velum penetrare possint.*"

These are all the passages I have been able to find, in which the advantage of keeping certain parts of knowledge reserved to a select audience is alluded to. And the question is whether the reserve which Bacon contemplated can be justly compared with that practised by the alchemists and others, who concealed their discoveries as "treasures of which the value would be decreased if others were allowed to share in it."

Now I would observe in the first place that though the expression "single and adopt his reader," or its equivalent, occurs in all these passages, and that too in immediate reference to the method

of delivery or transmission, yet in many of them the object of so singling and adopting the reader was certainly *not* to keep the knowledge secret; for many, indeed most, of them relate to that part of the subject which Bacon never proposed to reserve, but which was designed "edi in vulgus et per ora volitare." The part which he proposed to reserve is distinctly defined in the fourth extract as "ipsa interpretationis formula et inventa per eandem;" the part to be published is "ea quæ ad ingeniorum correspondentias captandas et mentium areas purgandas pertinent." Now it is unquestionably to this latter part that the second, the eighth, and the ninth extracts refer. "Primo enim," he says, in the *Partis secundæ Delineatio*, "mentis area æquanda et liberanda ab eis quæ hactenus recepta sunt." This he calls *Pars destruens*; and proposes to begin with the *Redargutio Philosophiarum*, from the introduction to which the eighth extract is taken. And the other two must of course be classed with it. Thus the "animi capaces et idonei" which he wishes "seponere et subire," are clearly identified with the minds marked up with chalk as capable of lodging and harbouring the truth, which are spoken of in the *Advancement*.

Next to the *Pars destruens* came the *Pars præparans*, the object of which was to prepare men's expectations for what was coming, and by dislodging erroneous preconceptions to make their minds ready for the reception of the truth. To this part belongs the seventh extract; and if the seventh, then the sixth, which evidently corresponds to it; and if the sixth, then the fifth, which is but the sixth condensed. Or if there be any doubt about the correspondence between the seventh and sixth, it will I think be removed by comparing them both with the following passage which winds up the description of the *Pars præparans* in the *Partis secundæ Delineatio*.

"Quod si cui supervacua videatur accurata ista nostra quam adhibemus ad mentes præparandas diligentia, atque cogitet hoc quiddam esse ex pompâ et in ostentationem compositum; itaque cupiat rem ipsam missis ambagibus et præstructionibus simpliciter exhiberi; certe optabilis nobis foret (si vera esset) hujusmodi insimulatio. Utinam enim tam proclive nobis esset difficultates et impedimenta vincere quam fastum inanem et falsum apparatum deponere. Verum hoc velimus homines existiment, nos haud nexplorato viam in tantâ solitudine inire, præsertim cum argu-

mentum hujusmodi præ manibus habeamus quod tractandi imperitiâ perdere et veluti exponere nefas sit. Itaque ex perpenso et perspecto tam rerum quam animorum statu, duriores fere aditus ad hominum mentes quam ad res ipsas invenimus, ac tradendi labores inveniendi laboribus haud multo leviores experimur, atque, quod in intellectualibus res nova fere est, morem gerimus, et tam nostras cogitationes quam aliorum simul bajulamus. Omne enim idolum vanum arte atque obsequio ac debito accessu subvertitur, vi et contentione atque incursione subitâ et abruptâ efferatur. . . . . Quâ in re accedit et alia quædam difficultas ex moribus nostris non parva, quod constantissimo decreto nobis ipsi sancivimus, ut candorem nostrum et simplicitatem perpetuo retineamus, nec per vana ad vera aditum quæramus; sed ita obsequio nostro moderemur ut tamen non per artificium aliquod vafrum aut imposturam aut aliquid simile imposturæ, sed tantummodo per ordinis lumen et novorum super saniorem partem veterum sollertem insitionem, nos nostrorum votorum compotes fore speremus."

Now all this was to precede and prepare for the exposition of the method of induction itself — the "formula ipsa interpretationis" — which alone it was proposed to reserve; and therefore we must understand the *legitimus lector* of the fifth and sixth extract, as corresponding with the "*animus capax et idoneus*" of the eighth and ninth; and with the mind "chalked and marked up" by truth as "capable to lodge and harbour it," of the second; and we must not suppose that the process of singling and adopting the fit reader was to be effected by any restraint in communication, or any obscurity in style, which should exclude others; but by presenting the truth in such a shape as should be least likely to shock prejudice or awaken contradiction, and most likely to win its way into those minds which were best disposed to receive it The object was to propagate knowledge so that it should grow and spread: the difficulty anticipated was not in excluding auditors, but in finding them.[1]

[1] It may be worth while perhaps to compare with these passages an expression which Bacon uses in his letter to Dr. Playfere, — proposing to him to translate the *Advancement of Learning* into Latin; where a similar meaning is conveyed under another image. "Wherefore since I have only taken upon me to ring a bell to call other wits together, which is the meanest office, it cannot but be consonant to my desire to have that bell heard as far as can be. And since they are but sparks which can work but upon matter prepared, I have the more reason to wish that those sparks may

Thus I conceive that six out of the ten passages under consideration must be set aside as not bearing at all upon the question at issue. Of the four that remain, two must be set aside in like manner, because though they directly allude to the practice of transmitting knowledge as a secret from hand to hand, they contain no evidence that Bacon approved of it. These are the third and the last, and come respectively from the *Advancement of Learning*, one of his earliest works, and from the *De Augmentis Scientiarum*, one of his latest. In both these works the object being to show in what departments the stock of knowledge then existing was defective, the various methods which have been or may be adopted for the transmission of knowledge are pointed out as a fit subject of inquiry, and the secret or enigmatical or aeroamatic method is described among the rest; but it is described only, not recommended.

There remain therefore only the first and the fourth extracts to be considered: and it is true that in both of these Bacon intimates an intention to reserve the communication of one part of his philosophy — the "formula ipsa interpretationis et inventa per eandem" — to certain fit and chosen persons. May we infer from the expressions which he there uses, that his object was to prevent it from becoming generally known, as being a treasure which would lose its value by being divulged? Such a supposition seems to me inconsistent not only with all we know of his proceedings, purposes, and aspirations, but with the very explanation with which he himself accompanies the suggestion. The fruits which he anticipated from his philosophy were not only intended for the benefit of all mankind, but were to be gathered in another generation. Is it conceivable that at any time of his life he would have willingly foregone the aid of any single fellow labourer, or that anything could have been more welcome than the prospect of a rapid and indefinite increase of those "legitima et optata ingenia" in whose hands it might be expected to thrive and spread? But setting general probabilities aside, let us look at the reasons which he himself assigns for the precaution which he meditates. Ask why in *Valerius Terminus* he proposes to reserve part of his discovery to "a private succession?" His answer is, first "for the *prevention of abuse* in the excluded;" that

fly abroad, *that they may the better find and light upon those minds and spirits that are apt to be kindled.*"

is, because if it should fall into incapable and unfit hands it will be misused and mismanaged: secondly, "for the *strengthening of affection* in the admitted;" that is, because the fit and capable will take more interest in the work when they feel that it is committed to their charge. Ask again why in the *Proœmium* he proposes to keep the Formula of interpretation private,—"intra legitima et optata ingenia clausa?" The answer is to the same effect—it will be "vegetior et munitior;" it will flourish better and be kept safer. And certainly if we refer to any of the many passages in which he has either enumerated the obstructions which had hitherto hindered the progress of knowledge, or described the qualifications, moral and intellectual, and the order of proceeding, which he considered necessary for the successful prosecution of the new philosophy, we may easily understand why he anticipated more hindrance than help from a popular audience.

Upon a review of the evidence therefore I see no reason to suspect that he had any other motive for his proposed reserve than that which he himself assigns; and I think we may conclude that he meant to withhold the publication of his Formula, not "as a secret of too much value to be lightly revealed," but as a subject too abstruse to be handled successfully except by the fit and few.

Note C.

On some changes in Bacon's treatment of his doctrine of Idols.

"When the doctrine of Idols" (says Mr. Ellis) "was thrown into its present form" [i. e. the form in which it appears in the *Novum Organum*, as contrasted with that in which it appears in the *Partis secundæ Delineatio*], "it ceased to afford a convenient basis for the *pars destruens*, and accordingly the substance of the three *Redargutiones* is in the *Novum Organum* less systematically set forth than Bacon purposed that it should be when he wrote the *Partis secundæ Delineatio*."

That the argument is set forth in the *Novum Organum* less systematically than Bacon originally intended, is no doubt true; for when he wrote the "Partis secundæ *Delineatio* et *Argumentum*,"

he meant to handle the subject regularly and completely, or (as he would himself have expressed it) "in Corpore tractatus justi;" and this in the entrance of the *Novum Organum*, which is the "Pars secunda" itself, we are expressly warned not to expect. "Sequitur secunda pars Instaurationis, quæ artem ipsam interpretandi Naturam et verioris adoperationis Intellectûs exhibet: *neque eam ipsam tamen in Corpore tractatûs justi;* sed tantùm *digestam per summas, in Aphorismos.*" A succession of aphorisms, not formally connected with each other, was probably the most convenient form for setting forth all that was most important in those parts of his work which he had ready; for without binding him to exhibit them in regular and apparent connexion, it left him at liberty to make the connexion as perfect and apparent as he pleased. But it has one disadvantage: the divisions between aphorism and aphorism tend to conceal from the eye the larger divisions between subject and subject. And hence arises the appearance (for I think it is only an appearance) of a deviation from the plan originally marked out for the treatment of the *pars destruens*. Between the publication of the *Advancement of Learning* and the composition of the *Novum Organum*, the doctrine of Idols underwent one considerable modification; but not, I think, the one here supposed. That modification was introduced *before* the *Partis secundæ Delineatio* was drawn up; and after that I cannot find evidence of any substantial change.

I will first exhibit the successive aspects which the doctrine assumes, and then give what I suppose to be the true history of them.

In the *Advancement of Learning*, the Idols, native and adventitious, of the human mind are distributed into three kinds; not distinguished as yet by names, but corresponding respectively to those of the Tribe, the Cave, and the Market-place. In *Valerius Terminus*, they are distributed into four kinds: the Tribe, the Palace (corresponding with the Market-place), the Cave, and the Theatre. In the *Partis secundæ Delineatio* they are distributed again into three, but classified quite differently. The two great divisions of Adventitious and Native are retained: "aut adscititia sunt . . . nimirum quæ immigrârunt in mentem, &c., aut ea quæ menti ipsi et substantiæ ejus inhærentia sunt et innata;" but the subdivisions are entirely changed;—the Adventitious being here divided into two kinds, neither of which is recognised at all in the

Advancement; the Native, which are divided into two kinds in the *Advancement*, not being divided at all here, but classed together as one. In the *Advancement* we find nothing corresponding to the Idols of the Theatre, to which belong *both* the kinds of adventitious Idols mentioned in the *Delineatio* — those derived *ex philosophorum placitis*, and those derived *ex perversis legibus demonstrationum;* — in the *Delineatio* we find nothing corresponding to the Idols of the Market-place, which among those mentioned in the *Advancement* are alone entitled to be classed as adventitious. Thus the difference between the two appears at first to be total and radical, amounting to an entire rearrangement of all the classes. Instead of Idols of the Tribe, the Cave, and the Market-place, we find Idols of the Philosophies, the Demonstrations, and the Human Mind.

But the truth is that Bacon, being now engaged in laying out the large outlines of his subject, omits the minor distinctions which belong to the development of it in detail, and leaves the particular distribution and description of those "fallacies and false appearances" which are "inseparable from our nature and condition in life" — those namely which he had spoken of in the *Advancement* — to be handled in the work itself. Having however, as he came into closer contact with his subject, foreseen the opposition which he must expect from prejudices and false appearances of another kind — prejudices which had no root in the mind itself, which were *not* "inseparable from our nature and condition in life," — mere immigrants and strangers that had come in and might be turned out, — namely, the belief in received systems and attachment to received methods of demonstration, — he had resolved to deal with these first; and therefore introduces them as a separate class, dividing them into two parts and assigning to each what we may call a separate chapter. These he afterwards called Idols of the Theatre, and treated them in the manner proposed; with this difference only — that he placed them last instead of first, and ran the two chapters into one.

This being allowed, it will be found that the one substantial change which the doctrine of Idols underwent was the admission of these Idola Theatri into the company, and that there is no real difference between the form of that doctrine as indicated in the *Delineatio* and as developed in the *Novum Organum*.

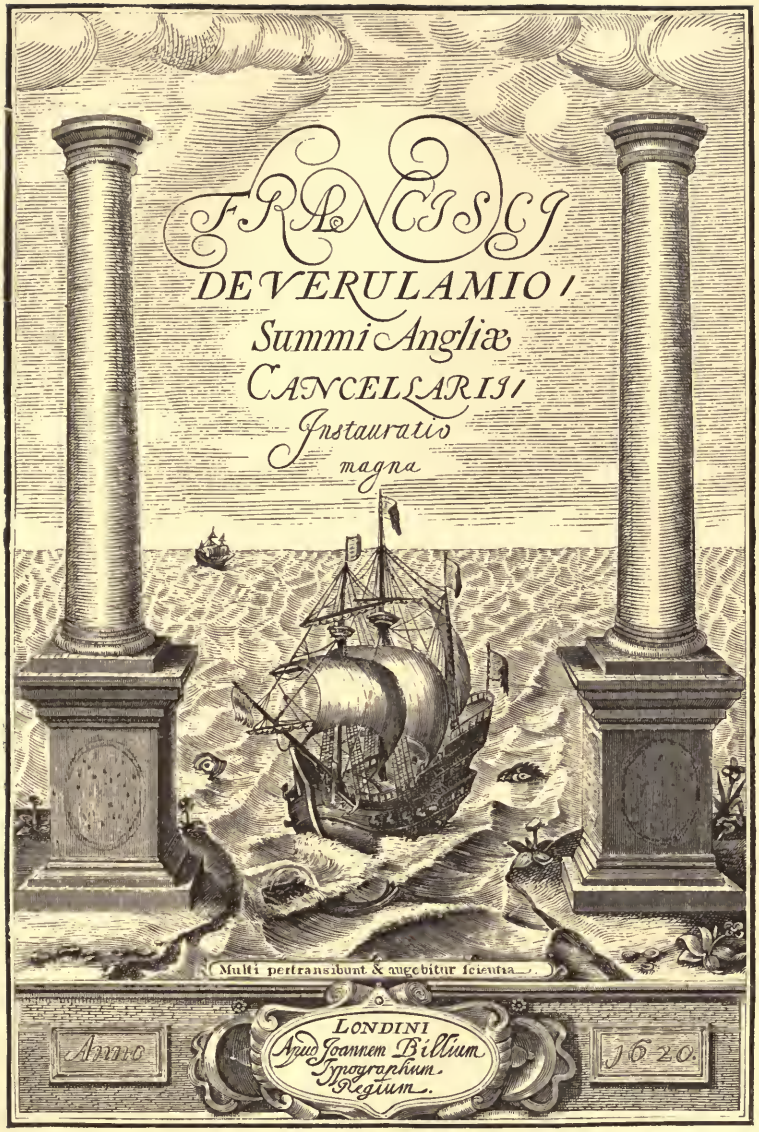
The only difficulty which this view of the subject presents is one

which may be probably enough accounted for as an oversight of Bacon's own. I mean the classification of the Idola Fori, the source of which is no doubt extraneous, among the natives. Bacon was never very careful about subtle logical distinctions, and in this case his attention had not as yet been specially called to the point. For in the *Advancement of Learning*, though the great division between Native and Adventitious appears to be recognised in the margin, there is no hint of it in the text, — the particular Idols not being arranged with any reference to those two general heads; while in *Valerius Terminus* the larger division is not alluded to at all, and the order in which the four Idols are there enumerated, — the first and third being of one class, the second and fourth of the other, — seems to prove that no such classification was then in his mind. Besides, it is to be remembered that the Idola Fori, however distinct in their origin, are in their nature and qualities much nearer akin to the other two than to the Idola Theatri. For though they come from without, yet when they are once in they naturalise themselves and take up their abode along with the natives, produce as much confusion, and can as hardly be expelled. Philosophical systems may be exploded, false methods of demonstration may be discarded, but intercourse of words is "inseparable from our condition in life."

At any rate, let the logical error implied be as large as it may, it is certain that Bacon did in fact always class these three together. Wherever he mentions the Idols of the Market-place with any reference to classification, they are grouped with those of the Tribe and the Cave, and distinguished from those of the Theatre. In the *Temporis Partus Masculus*, c. 2. (which is I think the earliest form of the *Redargutio Philosophiarum* though probably of later date than the *Delineatio*) we find "Nam Idola quisque sua (*non* jam *scenæ* dico, sed præcipue *fori et specûs*"), &c. In the *De Augmentis Scientiarum* where the four kinds of Idols are enumerated by name and in order, the line of separation is drawn not between the two first and the two last (as it would have been if Bacon had meant to balance the members of his classification on the "dichotomising principle," as suggested by Mr. Ellis, p. 161.), but between the three first and the fourth; the Idola Fori being classed along with the Idola Tribûs and Specûs, as "quæ plane obsident mentem, neque evelli possunt," the Idola Theatri being broadly distinguished from them, as "quæ abnegari possunt et

deponi," and which may therefore for the present be set aside. In the *Novum Organum* itself, though the divisions between aphorism and aphorism tend, as I have said, to obscure the divisions of subject, yet if we look carefully we shall see that the line of demarcation is drawn exactly in the same place, and almost as distinctly. For after speaking of the *three* first kinds of Idol, Bacon proceeds (Aph. 61.), "At Idola *Theatri* innata non sunt [like those of the Tribe and Cave] *nec occulto insinuata in Intellectum* [like those of the Market-place], sed ex fabulis theoriarum et perversis legibus demonstrationum plane indita et recepta." Lastly, in the *Distributio Operis*, where the particular Idols are not mentioned by name, but the more general classification of the *Delineatio* is retained, it is plain that under the class *Adscititia* he meant to include the Idols of the Theatre only — ("adscititia vero immigrârunt in mentes hominum, vel ex philosophorum placitis et sectis, vel ex perversis legibus demonstrationum") — and therefore he must still have meant to include the Idols of the Market-place, along with the two first, under the class *Innata*.

It is worthy of remark however that, in the *Novum Organum* itself, the distinction between Adscititia and Innata disappears. And the fact probably is that when he came to describe the several Idols one by one, he became aware both of the logical inconsistency of classing the Idola Fori among the Innata, and of the practical inconvenience of classing them among the Adscititia, and therefore resolved to drop the dichotomy altogether and range them in four co-ordinate classes. And it is the removal of this boundary line which makes it *seem* at first sight as if the arrangement were quite changed, whereas it is in fact only inverted. According to the plan of the *Partis secundæ Delineatio* and also of the *Distributio Operis*, the confutation of the Immigrants, — that is, the *Redargutio Philosophiarum* and *Redargutio Demonstrationum*, — was to have the precedence, and the confutation of the Natives, — that is, the *Redargutio Rationis humanæ nativæ*, — was to follow. As it is, he begins with the last and ends with the first. And the reason of this change of plan is not difficult to divine. The *Redargutio Philosophiarum*, as he handles it, traverses a wider and more various field, and rises gradually into a strain of prophetic anticipation, after which the *Redargutio Rationis* would have sounded flat.


FRANCISCI
DE VERULAMIO
Summi Angliæ
CANCELLARII
Instauratio
magna
Multi pertransibunt & augebitur scientia.
LONDINI
Apud Joannem Billium
Typographum
Regium.
Anno
1620.

FRANCISCUS DE VERULAMIO

SIC COGITAVIT;

TALEMQUE APUD SE RATIONEM INSTITUIT,

QUAM VIVENTIBUS ET POSTERIS NOTAM FIERI IPSORUM INTERESSE PUTAVIT.

Cum illi pro comperto esset intellectum humanum sibi ipsi negotium facessere, neque auxiliis veris (quæ in hominis potestate sunt) uti sobrie et commode; unde multiplex rerum ignoratio et ex ignoratione rerum detrimenta innumera: omni ope connitendum existimavit, si quo modo commercium istud Mentis et Rerum (cui vix aliquid in terris, aut saltem in terrenis, se ostendit simile) restitui posset in integrum, aut saltem in melius deduci. Ut vero errores qui invaluerunt, quique in æternum invalituri sunt, alii post alios (si mens sibi permittatur) ipsi se corrigerent, vel ex vi intellectus propria vel ex auxiliis atque adminiculis dialecticæ, nulla prorsus suberat spes; propterea quod notiones rerum primæ, quas mens haustu facili et supino excipit recondit atque accumulat (unde reliqua omnia fluunt), vitiosæ sint et confusæ et temere a rebus abstractæ; neque minor sit in secundis et reliquis libido et inconstantia; ex quo fit, ut universa ista ratio humana, qua utimur quoad inquisitionem naturæ non bene congesta et ædificata sit, sed tanquam moles aliqua magnifica sine fundamento. Dum enim falsas mentis vires mirantur homines et celebrant, veras ejusdem quæ esse possint (si debita ei adhibeantur auxilia, atque ipsa rebus morigera sit, nec impotenter rebus insultet) prætereunt et perdunt. Restabat illud unum ut res de integro tentetur melioribus præsidiis, utque fiat scientiarum et artium atque omnis humanæ doctrinæ in universum Instauratio, a debitis excitata fundamentis. Hoc vero licet aggressu infinitum quiddam videri possit ac supra vires mortales, tamen idem tractatu sanum invenietur ac sobrium, magis quam ea quæ adhuc facta sunt. Exitus enim

hujus rei est nonnullus. In iis vero quæ jam fiunt circa scientias, est vertigo quædam et agitatio perpetua et circulus. Neque eum fugit quanta in solitudine versetur hoc experimentum, et quam durum et incredibile sit ad faciendam fidem. Nihilominus, nec rem nec seipsum deserendum putavit, quin viam quæ una humanæ menti pervia est tentaret atque iniret. Præstat enim principium dare rei quæ exitum habere possit, quam in iis quæ exitum nullum habent perpetua contentione et studio implicari. Viæ autem contemplativæ viis illis activis decantatis fere respondent; ut altera, ab initio ardua et difficilis, desinat in apertum; altera, primo intuitu expedita et proclivis, ducat in avia et præcipitia. Quum autem incertus esset quando hæc alicui posthac in mentem ventura sint; eo potissimum usus argumento, quod neminem hactenus invenit qui ad similes cogitationes animum applicuerit; decrevit prima quæque quæ perficere licuit in publicum edere. Neque hæc festinatio ambitiosa fuit, sed sollicita; ut si quid illi humanitus accideret, extaret tamen designatio quædam ac destinatio rei quam animo complexus est; utque extaret simul signum aliquod honestæ suæ et propensæ in generis humani commoda voluntatis. Certe aliam quamcunque ambitionem inferiorem duxit re quam præ manibus habuit. Aut enim hoc quod agitur nihil est, aut tantum, ut merito ipso contentum esse debeat nec fructum extra quærere.

SERENISSIMO

POTENTISSIMOQUE PRINCIPI AC DOMINO NOSTRO,

JACOBO,

DEI GRATIA

MAGNÆ BRITANNIÆ, FRANCIÆ, ET HIBERNIÆ REGI,

FIDEI DEFENSORI, ETC.

Serenissime Potentissimeque Rex,

Poterit fortasse Majestas tua me furti incusare, quod tantum temporis quantum ad hæc sufficiat negotiis tuis suffuratus sim. Non habeo quod dicam. Temporis enim non fit restitutio; nisi forte quod detractum fuerit temporis rebus tuis, id memoriæ nominis tui et honori sæculi tui reponi possit; si modo hæc alicujus sint pretii. Sunt certe prorsus nova; etiam toto genere: sed descripta ex veteri admodum exemplari, mundo scilicet ipso, et natura rerum et mentis. Ipse certe (ut ingenue fatear) soleo æstimare hoc opus magis pro partu temporis quam ingenii. Illud enim in eo solummodo mirabile est, initia rei et tantas de iis quæ invaluerunt suspiciones alicui in mentem venire potuisse. Cætera non illibenter sequuntur. At versatur proculdubio casus (ut loquimur) et quiddam quasi fortuitum non minus in iis quæ cogitant homines quam in iis quæ agunt aut loquuntur. Verum hunc casum (de quo loquor) ita intelligi volo, ut si quid in his quæ affero sit boni, id immensæ misericordiæ et bonitati divinæ et fœlicitati temporum tuorum tribuatur: cui et vivus integerrimo affectu servivi, et mortuus fortasse id effecero, ut illa posteritati, nova

hac accensa face in philosophiæ tenebris, prælucere possint Merito autem temporibus regis omnium sapientissimi et doctissimi Regeneratio ista et Instauratio scientiarum debetur. Superest petitio, Majestate tua non indigna, et maxime omnium faciens ad id quod agitur. Ea est, ut quando Salomonem in plurimis referas, judiciorum gravitate, regno pacifico, cordis latitudine, librorum denique quos composuisti nobili varietate, etiam hoc ad ejusdem regis exemplum addas, ut cures Historiam Naturalem et Experimentalem, veram et severam (missis philologicis), et quæ sit in ordine ad condendam philosophiam, denique qualem suo loco describemus, congeri et perfici: ut tandem post tot mundi ætates philosophia et scientiæ non sint amplius pensiles et aëreæ, sed solidis experientiæ omnigenæ, ejusdemque bene pensitatæ, nitantur fundamentis. Equidem Organum præbui; verum materies a rebus ipsis petenda est. Deus Opt. Max. Majestatem tuam diu servet incolumem.

Serenissimæ Majestati tuæ

Servus devinctissimus,

et devotissimus,

FRANCISCUS VERULAM,

CANCELLARIUS.

FRANCISCI DE VERULAMIO

INSTAURATIO MAGNA.

PRÆFATIO.

De statu scientiarum, quod non sit fœlix aut majorem in modum auctus; quodque alia omnino quam prioribus cognita fuerit via aperienda sit intellectui humano, et alia comparanda auxilia, ut mens suo jure in rerum naturam uti possit.

VIDENTUR nobis homines nec opes nec vires suas bene nosse; verum de illis majora quam par est, de his minora credere. Ita fit, ut aut artes receptas insanis pretiis æstimantes nil amplius quærant, aut seipsos plus æquo contemnentes vires suas in levioribus consumant, in iis quæ ad summam rei faciant non experiantur. Quare sunt et suæ scientiis columnæ tanquam fatales; cum ad ulterius penetrandum homines nec desiderio nec spe excitentur. Atque cum opinio copiæ inter maximas causas inopiæ sit; quumque ex fiducia præsentium vera auxilia negligantur in posterum; ex usu est, et planè ex necessitate, ut ab illis quæ adhuc inventa sunt in ipso operis nostri limine (idque relictis ambagibus et non dissimulanter) honoris et admirationis excessus tollatur; utili monito, ne homines eorum

aut copiam aut utilitatem in majus accipiant[1] aut celebrent. Nam si quis in omnem illam librorum varietatem qua artes et scientiæ exultant diligentius introspiciat, ubique inveniet ejusdem rei repetitiones infinitas, tractandi modis diversas, inventione præoccupatas;[2] ut omnia primo intuitu numerosa, facto examine pauca reperiantur. Et de utilitate aperte dicendum est, sapientiam istam quam a Græcis potissimum hausimus pueritiam quandam scientiæ videri, atque habere quod proprium est puerorum, ut ad garriendum prompta, ad generandum invalida et immatura sit. Controversiarum enim ferax, operum effœta est. Adeo ut fabula illa de Scylla in literarum statum, qualis habetur, ad vivum quadrare videatur; quæ virginis os et vultum extulit, ad uterum vero monstra latrantia succingebantur et adhærebant. Ita habent et scientiæ quibus insuevimus generalia quædam blandientia et speciosa, sed cum ad particularia ventum sit, veluti ad partes generationis, ut fructum et opera ex se edant, tum contentiones et oblatrantes disputationes exoriuntur, in quas desinunt, et quæ partus locum obtinent. Præterea, si hujusmodi scientiæ plane res mortua non essent, id minime videtur eventurum fuisse quod per multa jam sæcula usu venit, ut illæ suis immotæ fere hæreant vestigiis, nec incrementa genere humano digna sumant: eo usque, ut sæpenumero non solum assertio maneat assertio sed etiam quæstio maneat quæstio, et per disputationes non solvatur sed figatur et alatur, omnisque traditio et successio disciplinarum repræsentet et exhibeat personas magistri et auditoris, non

[1] Exaggerate.

[2] Anticipated, so far as relates to originality of invention. (One of Bacon's antitheses between "inventione" and "modis tractandi.")

inventoris et ejus qui inventis aliquid eximium adjiciat. In artibus autem mechanicis contrarium evenire videmus; quæ, ac si auræ cujusdam vitalis forent participes, quotidie crescunt et perficiuntur, et in primis authoribus rudes plerunque et fere onerosæ et informes apparent, postea vero novas virtutes et commoditatem quandam adipiscuntur, eo usque, ut citius studia hominum et cupiditates deficiant et mutentur, quam illæ ad culmen et perfectionem suam pervenerint. Philosophia contra et scientiæ intellectuales, statuarum more, adorantur et celebrantur, sed non promoventur. Quin etiam in primo nonnunquam authore maxime vigent, et deinceps degenerant. Nam postquam homines deditii facti sint et in unius sententiam (tanquam pedarii senatores) coierint, scientiis ipsis amplitudinem non addunt, sed in certis authoribus ornandis et stipandis servili officio funguntur. Neque illud afferat quispiam, scientias paullatim succrescentes tandem ad statum quendam pervenisse, et tum demum (quasi confectis spatiis legitimis) in operibus paucorum sedes fixas posuisse; atque postquam nil melius inveniri potuerit, restare scilicet ut quæ inventa sint exornentur et colantur. Atque optandum quidem esset hæc ita se habuisse. Rectius illud et verius, istas scientiarum mancipationes nil aliud esse quam rem ex paucorum hominum confidentia et reliquorum socordia et inertia natam. Postquam enim scientiæ per partes diligenter fortasse excultæ et tractatæ fuerint, tum forte exortus est aliquis, ingenio audax et propter methodi compendia acceptus et celebratus, qui specie tenus artem constituerit, revera veterum labores corruperit. Id tamen posteris gratum esse solet, propter usum operis expeditum et inquisitionis novæ tædium et impatientiam. Quod si quis consensu jam inveterato tan-

quam temporis judicio moveatur, sciat se ratione admodum fallaci et infirma niti. Neque enim nobis magna ex parte notum est, quid in scientiis et artibus, variis sæculis et locis, innotuerit et in publicum emanarit; multo minus, quid a singulis tentatum sit et secreto agitatum. Itaque nec temporis partus nec abortus extant in fastis. Neque ipse consensus ejusque diuturnitas magni prorsus æstimandus est. Utcunque enim varia sint genera politiarum, unicus est status scientiarum, isque semper fuit et mansurus est popularis. Atque apud populum plurimum vigent doctrinæ aut contentiosæ et pugnaces aut speciosæ et inanes, quales videlicet assensum aut illaqueant aut demulcent. Itaque maxima ingenia proculdubio per singulas ætates vim passa sunt; dum viri captu et intellectu non vulgares, nihilo secius existimationi suæ consulentes, temporis et multitudinis judicio se submiserint. Quamobrem altiores contemplationes si forte usquam emicuerint, opinionum vulgarium ventis subinde agitatæ sunt et extinctæ. Adeo ut Tempus, tanquam fluvius, levia et inflata ad nos devexerit, gravia et solida demerserit. Quin et illi ipsi authores qui dictaturam quandam in scientiis invaserunt et tanta confidentia de rebus pronuntiant, cum tamen per intervalla ad se redeunt, ad querimonias de subtilitate naturæ, veritatis recessibus, rerum obscuritate, causarum implicatione, ingenii humani infirmitate, se convertunt; in hoc nihilo tamen modestiores, cum malint communem hominum et rerum conditionem causari quam de seipsis confiteri. Quin illis hoc fere solenne est, ut quicquid ars aliqua non attingat id ipsum ex eadem arte impossibile esse statuant. Neque vero damnari potest ars, quum ipsa disceptet et judicet. Itaque id agitur, ut ignorantia etiam

ab ignominia liberetur. Atque quæ tradita et recepta sunt ad hunc fere modum se habent: quoad opera sterilia, quæstionum plena; incrementis suis tarda et languida; perfectionem in toto simulantia, sed per partes male impleta; delectu autem popularia et authoribus ipsis suspecta, ideoque artificiis quibusdam munita et ostentata.[1] Qui autem et ipsi experiri et se scientiis addere earumque fines proferre statuerunt, nec illi a receptis prorsus desciscere ausi sunt, nec fontes rerum petere. Verum se magnum quiddam consequutos putant si aliquid ex proprio inserant et adjiciant; prudenter secum reputantes, se in assentiendo modestiam, in adjiciendo libertatem tueri posse. Verum dum opinionibus et moribus consulitur, mediocritates istæ laudatæ in magnum scientiarum detrimentum cedunt. Vix enim datur authores simul et admirari et superare. Sed fit aquarum more, quæ non altius ascendunt quam ex quo descenderunt. Itaque hujusmodi homines emendant nonnulla sed parum promovent, et proficiunt in melius non in majus. Neque tamen defuerunt, qui ausu majore omnia integra sibi duxerunt, et ingenii impetu usi, priora prosternendo et destruendo aditum sibi et placitis suis fecerunt; quorum tumultu non magnopere profectum est; quum philosophiam et artes non re ac opere amplificare, sed placita tantum permutare atque regnum opinionum in se transferre contenderint; exiguo sane fructu, quum inter errores oppositos errandi causæ sint fere communes. Si qui autem nec alienis nec propriis placitis obnoxii, sed libertati faventes, ita animati fuere ut alios secum simul quærere

[1] So selected as to favour popular notions, while at the same time their truth is doubted even by those who propound them, on which account they are fenced round and set forth with sundry artifices.

cuperent; illi sane affectu honesti, sed conatu invalidi fuerunt. Probabiles enim tantum rationes secuti videntur, et argumentorum vertigine circumaguntur, et promiscua quærendi licentia severitatem inquisitionis enervarunt. Nemo autem reperitur, qui in rebus ipsis et experientia moram fecerit legitimam. Atque nonnulli rursus qui experientiæ undis se commisere et fere mechanici facti sunt, tamen in ipsa experientia erraticam quandam inquisitionem exercent, nec ei[1] certâ lege militant. Quin et plerique pusilla quædam pensa sibi proposuere, pro magno ducentes si unum aliquod inventum eruere possint; instituto non minus tenui, quam imperito. Nemo enim rei alicujus naturam in ipsa re recte aut fœliciter perscrutatur; verum post laboriosam experimentorum variationem non acquiescit, sed invenit quod ulterius quærat. Neque illud imprimis omittendum est, quod omnis in experiendo industria statim ab initio opera quædam destinata præpropero et intempestivo studio captavit; fructifera (inquam) experimenta, non lucifera, quæsivit; nec ordinem divinum imitata est, qui primo die lucem[2] tantum creavit, eique unum diem integrum attribuit; neque illo die quicquam materiati operis produxit, verum sequentibus diebus ad ea descendit. At qui summas dialecticæ partes tribuerunt atque inde fidissima scientiis præsidia comparari putarunt, verissime et optime viderunt intellectum humanum sibi permissum merito suspectum esse debere. Verum infirmior omnino est malo medi-

[1] In its service.

[2] The light created on the first day is by many divines supposed to be not a corporeal but a spiritual light. This is the doctrine of S. Augustine; who however does not say that those who adopt a contrary opinion are necessarily wrong. This idea of a spiritual light was developed at great length in connexion with the theory of the nature and cognition of angels.

cina; nec ipsa mali expers. Siquidem dialectica quæ recepta est, licet ad civilia et artes quæ in sermone et opinione positæ sunt rectissime adhibeatur, naturæ tamen subtilitatem longo intervallo non attingit; et prensando quod non capit, ad errores potius stabiliendos et quasi figendos quam ad viam veritati aperiendam valuit.

Quare, ut quæ dicta sunt complectamur, non videtur hominibus aut aliena fides aut industria propria circa scientias hactenus fœliciter illuxisse; præsertim quum et in demonstrationibus et in experimentis adhuc cognitis parum sit præsidii. Ædificium autem hujus universi structura sua, intellectui humano contemplanti, instar labyrinthi est; ubi tot ambigua viarum, tam fallaces rerum et signorum similitudines, tam obliquæ et implexæ naturarum spiræ et nodi, undequaque se ostendunt. Iter autem sub incerto sensus lumine, interdum affulgente interdum se condente, per experientiæ et rerum particularium sylvas perpetuo faciendum est. Quin etiam duces itineris (ut dictum est) qui se offerunt, et ipsi implicantur, atque errorum et errantium numerum augent. In rebus tam duris, de judicio hominum ex vi propria, aut etiam de fœlicitate fortuita, desperandum est. Neque enim ingeniorum quantacunque excellentia, neque experiendi alea sæpius repetita, ista vincere queat. Vestigia filo regenda sunt: omnisque via, usque a primis ipsis sensuum perceptionibus, certa ratione munienda. Neque hæc ita accipienda sunt, ac si nihil omnino tot sæculis, tantis laboribus, actum sit. Neque enim eorum quæ inventa sunt nos pœnitet. Atque antiqui certe, in iis quæ in ingenio et meditatione abstracta posita sunt, mirabiles se viros præstitere. Verum quemadmodum sæculis

prioribus, cum homines in navigando per stellarum tantum observationes cursum dirigebant, veteris sane continentis oras legere potuerunt, aut maria aliqua minora et mediterranea trajicere; priusquam autem oceanus trajiceretur et novi orbis regiones detegerentur, necesse fuit usum acus nauticæ, ut ducem viæ magis fidum et certum, innotuisse: simili prorsus ratione, quæ hucusque in artibus et scientiis inventa sunt, ea hujusmodi sunt ut usu, meditatione, observando, argumentando, reperiri potuerint; utpote quæ sensibus propiora sint et communibus notionibus fere subjaceant; antequam vero ad remotiora et occultiora naturæ liceat appellere, necessario requiritur ut melior et perfectior mentis et intellectus humani usus et adoperatio introducatur.

Nos certe, æterno veritatis amore devicti, viarum incertis et arduis et solitudinibus nos commisimus; et divino auxilio freti et innixi, mentem nostram et contra opinionum violentias et quasi instructas acies, et contra proprias et internas hæsitationes et scrupulos, et contra rerum caligines et nubes et undequaque volantes phantasias, sustinuimus; ut tandem magis fida et secura indicia viventibus et posteris comparare possemus. Qua in re si quid profecerimus, non alia sane ratio nobis viam aperuit quam vera et legitima spiritus humani humiliatio. Omnes enim ante nos, qui ad artes inveniendas se applicuerunt, conjectis paulisper in res et exempla et experientiam oculis, statim, quasi inventio nil aliud esset quam quædam excogitatio, spiritus proprios ut sibi oracula exhiberent quodammodo invocarunt. Nos vero inter res caste et perpetuo versantes, intellectum longius a rebus non abstrahimus quam ut rerum imagines et radii (ut in sensu fit) coire pos-

sint;[1] unde fit, ut ingenii viribus et excellentiæ non multum relinquatur. Atque quam in inveniendo adhibemus humilitatem, eandem et in docendo sequuti sumus. Neque enim aut confutationum triumphis, aut antiquitatis advocationibus, aut authoritatis usurpatione quadam, aut etiam obscuritatis velo, aliquam his nostris inventis majestatem imponere aut conciliare conamur; qualia reperire non difficile esset ei, qui nomini suo non animis aliorum lumen affundere conaretur. Non (inquam) ullam aut vim aut insidias hominum judiciis fecimus aut paramus; verum eos ad res ipsas et rerum fœdera adducimus; ut ipsi videant quid habeant, quid arguant, quid addant atque in commune conferant. Nos autem si qua in re vel male credidimus, vel obdormivimus et minus attendimus, vel defecimus in via et inquisitionem abrupimus, nihilominus iis modis res nudas et apertas exhibemus, ut errores nostri, antequam scientiæ massam altius inficiant, notari et

[1] To explain the illustration of which Bacon here makes use, it is in the first place to be remarked that *radius* is not to be rendered by *ray*, but by *visual cone*. "Radium visualem speciem rei visibilis dicimus: non ut lineam aut superficiem mathematicam profundo carentem, sed corporalem et pyramidalem, cujus basis in re visâ et conus in oculo videntis est." — Marg. Phil. x. 2. c. 11. Again Telesius, whose theory of vision was adopted by Bacon, says, "quæ a re quæ spectatur relucet lux universa quidem unum in pupillâ coit in punctum," thus forming the "radius" just mentioned. Lastly Telesius goes on to say, "ab illarum [rerum sc.] puncto quovis illa [lux sc.] relucet, et vel ubi in unum coit punctum universa ibi fit, itaque et rerum a quibus relucet imagines et ipsæ [sic enim legendum] in eodem fiunt puncto." These "imagines" then are therefore in some unexplained manner borne along by the light which constitutes the visual cone, and exist virtually if not formally at the apex from which the light dispersing in an inverse cone falls ultimately (still bearing them with it) on the vitreous humour, which is in this system the sphere of vision. Bacon's expressions therefore amount simply to this, that the eye must be at a certain distance from the object in order that an effectual visual cone may be formed. He does not speak either of optical images or of rays, in the senses which we attach to those words. See *Telesius, De Rerum Naturâ*, vi. c. 23 and 24.

separari possint; atque etiam ut facilis et expedita sit laborum nostrorum continuatio. Atque hoc modo inter empiricam et rationalem facultatem (quarum morosa et inauspicata divortia et repudia omnia in humana familia turbavere) conjugium verum et legitimum in perpetuum nos firmasse existimamus.[1]

Quamobrem, quum hæc arbitrii nostri non sint, in principio operis, ad Deum Patrem, Deum Verbum, Deum Spiritum, preces fundimus humillimas et ardentissimas, ut humani generis ærumnarum memores et peregrinationis istius vitæ in qua dies paucos et malos terimus, novis suis eleemosynis, per manus nostras, familiam humanam dotare dignentur. Atque illud insuper supplices rogamus, ne humana divinis officiant, neve ex reseratione viarum sensus et accensione majore luminis naturalis aliquid incredulitatis et noctis animis nostris erga divina mysteria oboriatur: sed potius, ut ab intellectu puro, a phantasiis et vanitate repurgato et divinis oraculis nihilominus subdito et prorsus dedititio, fidei dentur quæ fidei sunt. Postremo, ut scientiæ veneno a serpente infuso, quo animus humanus tumet et inflatur, deposito, nec altum sapiamus nec ultra sobrium, sed veritatem in charitate colamus.

Peractis autem votis, ad homines conversi, quædam et salutaria monemus et æqua postulamus. Monemus primum (quod etiam precati sumus) ut homines sensum in officio, quoad divina, contineant. Sensus enim (instar solis) globi terrestris faciem aperit, cœlestis claudit et obsignat.[2] Rursus, ne hujusce mali fuga

[1] This is one of the passages which show that Bacon did not imagine that the empirical faculty was the only thing to be considered in the philosophy of science, but that he recognised another coordinate element.

[2] This image, which in the *Advancement of Learning* and in the *De Aug-*

in contrarium peccent; quod certe fiet, si naturæ inquisitionem ulla ex parte veluti interdicto separatam putant. Neque enim pura illa et immaculata scientia naturalis, per quam Adam nomina ex proprietate rebus imposuit, principium aut occasionem lapsui dedit. Sed ambitiosa illa et imperativa scientiæ moralis, de bono et malo dijudicantis, cupiditas, ad hoc ut Homo a Deo deficeret et sibi ipsi leges daret, ea demum ratio atque modus tentationis fuit. De scientiis autem quæ naturam contemplantur sanctus ille philosophus pronuntiat, *Gloriam Dei esse celare rem; gloriam regis autem rem invenire:* non aliter ac si divina natura innocenti et benevolo puerorum ludo delectaretur, qui ideo se abscondunt ut inveniantur; atque animam humanam sibi collusorem in hoc ludo pro sua in homines indulgentia et bonitate cooptaverit. Postremo omnes in universum monitos volumus, ut scientiæ veros fines cogitent; nec eam aut animi causa petant, aut ad

mentis Bacon quotes from "one of Plato's school," is taken from Philo Judæus, perhaps the most poetical of the Neo-Platonists. "Post exortum ejus [solis scilicet] illustrantur in terris omnia, in cœlo vero eclantur; e diverso, post ejus occasum sidera quidem promicant, terrestria vero cuncta obteguntur umbris supervenientibus: ad eundem modum res nostræ se habent; quoties sensuum splendor tanquam sol oritur, tunc scientiæ reverâ cœlestes occultantur: quoties autem ad occasum accedit, tunc fulgentissimæ virtutum stellæ se proferunt, quando etiam mens ipsa re nullâ velante fit sensibilis." — *Philo. Jud., Quod somnia mittantur a Deo.* (I quote from the version of Gelenius.)

Nearly the same idea appears to be expressed in the *Bhagavad Gita*, fi. 69.:

> Welche jedem Geschöpf Nacht ist, in der wacht der Gesammelte;
> In der jeglich Geschöpf wachet, ist des schauenden Weisen Nacht.
> *S. W. v. Humboldt's Works*, i. 84

Which might be thus rendered in the Latin of the middle ages:—

> In nocte creaturæ vigilat internus homo;
> Cum autem vigilat creatura, contemplativo nox est.

contentionem, aut ut alios despiciant, aut ad commodum, aut ad famam, aut ad potentiam, aut hujusmodi inferiora; sed ad meritum et usus vitæ; eamque in charitate perficiant et regant. Ex appetitu enim potentiæ angeli lapsi sunt; ex appetitu scientiæ, homines; sed charitatis non est excessus; neque angelus aut homo per eam unquam in periculum venit.

Postulata autem nostra quæ afferimus talia sunt. De nobis ipsis silemus: de re autem quæ agitur petimus, ut homines eam non opinionem sed opus esse cogitent; ac pro certo habeant, non sectæ nos alicujus aut placiti, sed utilitatis et amplitudinis humanæ fundamenta moliri. Deinde ut suis commodis æqui, exutis opinionum zelis et præjudiciis, in commune consulant; ac ab erroribus viarum atque impedimentis, nostris præsidiis et auxiliis, liberati et muniti, laborum qui restant et ipsi in partem veniant. Præterea, ut bene sperent; neque *Instaurationem* nostram, ut quiddam infinitum et ultra mortale, fingant et animo concipiant; quum revera sit infiniti erroris finis et terminus legitimus; mortalitatis autem et humanitatis non sit immemor; quum rem non intra unius ætatis curriculum omnino perfici posse confidat, sed successioni destinet; denique scientias, non per arrogantiam in humani ingenii cellulis, sed submisse in mundo majore quærat. Vasta vero ut plurimum solent esse, quæ inania: solida contrahuntur maxime, et in parvo sita sunt. Postremo etiam petendum videtur (ne forte quis rei ipsius periculo nobis iniquus esse velit) ut videant homines, quatenus ex eo quod nobis asserere necesse sit (si modo nobis ipsi constare velimus) de his nostris opinandi aut sententiam ferendi sibi jus

permissum putent: quum nos omnem istam rationem humanam præmaturam, anticipantem, et a rebus temere et citius quam oportuit abstractam, (quatenus ad inquisitionem naturæ) ut rem variam et perturbatam et male extructam rejiciamus. Neque postulandum est ut ejus judicio stetur, quæ ipsa in judicium vocatur.

DISTRIBUTIO OPERIS.

Ejus constituuntur Partes sex.

Prima ; *Partitiones Scientiarum.*

Secunda ; *Novum Organum*, sive *Indicia de Interpretatione Naturæ.*

Tertia ; *Phænomena Universi*, sive *Historia Naturalis et Experimentalis ad condendam Philosophiam.*

Quarta ; *Scala Intellectus.*

Quinta ; *Prodromi*, sive *Anticipationes Philosophiæ Secundæ.*

Sexta ; *Philosophia Secunda*, sive *Scientia Activa.*

Singularum Argumenta.

Pars autem instituti nostri est, ut omnia, quantum fieri potest, aperte et perspicue proponantur. Nuditas enim animi, ut olim corporis, innocentiæ et simplicitatis comes est. Pateat itaque primo, ordo operis atque ratio ejus. Partes operis a nobis constituuntur sex.

Prima pars exhibet scientiæ ejus sive doctrinæ in cujus possessione humanum genus hactenus versatur, Summam, sive descriptionem universalem. Visum enim est nobis etiam in iis quæ recepta sunt nonnullam facere moram : eo nimirum consilio, ut facilius et verteribus perfectio et novis aditus detur. Pari enim

fere studio ferimur et ad vetera excolenda et ad ulteriora assequenda. Pertinet etiam hoc ad faciendam fidem: juxta illud, *Non accipit indoctus verba scientiæ, nisi prius ea dixeris quæ versantur in corde ejus.* Itaque scientiarum atque artium receptarum oras legere, necnon utilia quædam in illas importare, tanquam in transitu, non negligemus.

Partitiones tamen Scientiarum adhibemus eas, quæ non tantum jam inventa et nota, sed hactenus omissa et debita, complectantur. Etenim inveniuntur in globo intellectuali, quemadmodum in terrestri, et culta pariter et deserta. Itaque nil mirum videri debet, si a divisionibus usitatis quandoque recedamus. Adjectio enim, dum totum variat, etiam partes earumque sectiones necessario variat: receptæ autem divisiones receptæ summæ scientiarum, qualis nunc est, tantum competunt.

Circa ea vero quæ ceu omissa notabimus, ita nos geremus, ut non leves tantum titulos et argumenta concisa eorum quæ desiderantur proponamus. Nam siquid inter omissa retulerimus (modo sit dignioris subjecti) cujus ratio paulo videatur obscurior, adeo ut merito suspicari possimus homines non facile intellecturos quid nobis velimus aut quale sit illud opus quod animo et cogitatione complectimur, perpetuo nobis curæ erit aut præcepta hujusmodi operis conficiendi aut etiam partem operis ipsius jam a nobis confectam ad exemplum totius subjungere; ut in singulis aut opera aut consilio juvemus. Etenim etiam ad nostram existimationem, non solum aliorum utilitatem, pertinere putavimus, ne quis arbitretur levem aliquam de istiusmodi rebus notionem mentem nostram perstrinxisse, atque esse illa quæ desideramus ac prensamus tanquam votis similia. Ea vero talia sunt, quorum

et penes homines (nisi sibi ipsi desint) potestas plane sit, et nos apud nosmet rationem quandam certam et explicatam habeamus. Neque enim regiones metiri animo, ut augures, auspiciorum causa: sed intrare, ut duces, promerendi studio,[1] suscepimus. *Atque hæc prima operis pars est.*

Porro prætervecti artes veteres, intellectum humanum ad trajiciendum instruemus. Destinatur itaque parti secundæ, doctrina de meliore et perfectiore usu rationis in rerum inquisitione, et de auxiliis veris intellectus: ut per hoc (quantum conditio humanitatis ac mortalitatis patitur) exaltetur intellectus, et facultate amplificetur ad naturæ ardua et obscura superanda. Atque est ea quam adducimus ars (quam *Interpretationem Naturæ* appellare consuevimus) ex genere logicæ; licet plurimum, atque adeo immensum quiddam, intersit. Nam et ipsa illa logica vulgaris auxilia et præsidia intellectui moliri ac parare profitetur: et in hoc uno consentiunt. Differt autem plane a vulgari rebus præcipue tribus: viz. ipso fine, ordine demonstrandi, et inquirendi initiis.

Nam huic nostræ scientiæ finis proponitur, ut inveniantur non argumenta sed artes, nec principiis consentanea sed ipsa principia, nec rationes probabiles sed designationes et indicationes Operum. Itaque ex intentione diversa diversus sequitur effectus. Illic enim adversarius disputatione vincitur et constringitur, hic natura opere.

Atque cum hujusmodi fine conveniunt demonstrationum ipsarum natura et ordo. In logica enim vulgari opera fere universa circa Syllogismum consumitur.

[1] Purposing to deserve well of their country.

De Inductione vero Dialectici vix serio cogitasse videntur; levi mentione eam transmittentes, et ad disputandi formulas properantes. At nos demonstrationem per syllogismum rejicimus, quod confusius agat, et naturam emittat e manibus. Tametsi enim nemini dubium esse possit quin, quæ in medio termino conveniunt, ea et inter se conveniant (quod est mathematicæ cujusdam certitudinis): nihilominus hoc subest fraudis, quod syllogismus ex propositionibus constet, propositiones ex verbis, verba autem notionum tesseræ et signa sint. Itaque si notiones ipsæ mentis (quæ verborum quasi anima sunt, et totius hujusmodi structuræ ac fabricæ basis) male ac temere a rebus abstractæ, et vagæ, nec satis definitæ et circumscriptæ, denique multis modis vitiosæ fuerint, omnia ruunt. Rejicimus igitur syllogismum; neque id solum quoad principia (ad quæ nec illi eam adhibent) sed etiam quoad propositiones medias, quas educit sane atque parturit utcunque syllogismus, sed operum steriles et a practica remotas et plane quoad partem activam scientiarum incompetentes. Quamvis igitur relinquamus syllogismo et hujusmodi demonstrationibus famosis ac jactatis jurisdictionem in artes populares et opinabiles (nil enim in hac parte movemus), tamen ad naturam rerum Inductione per omnia, et tam ad minores propositiones quam ad majores, utimur. *Inductionem* enim censemus eam esse demonstrandi formam, quæ sensum tuetur et naturam premit et operibus imminet ac fere immiscetur.

Itaque ordo quoque demonstrandi plane invertitur. Adhuc enim res ita geri censuevit; ut a sensu et particularibus primo loco ad maxime generalia advoletur, tanquam ad polos fixos circa quos disputationes vertantur; ab illis cætera per media deriventur: via certe

compendiaria, sed præcipiti, et ad naturam impervia, ad disputationes vero proclivi et accommodata. At secundum nos, axiomata[1] continenter et gradatim excitantur, ut non nisi postremo loco ad generalissima veniatur: ea vero generalissima evadunt non notionalia, sed bene terminita, et talia quæ natura ut revera sibi notiora agnoscat,[2] quæque rebus hæreant in medullis.

At in forma ipsa quoque inductionis, et judicio quod per eam fit, opus longe maximum movemus. Ea enim de qua dialectici loquuntur, quæ procedit per enumerationem simplicem, puerile quiddam est, et precario concludit, et periculo ab instantia contradictoria exponitur, et consueta tantum intuetur, nec exitum reperit.

Atqui opus est ad scientias inductionis forma tali, quæ experientiam solvat et separet, et per exclusiones ac rejectiones debitas necessario concludat. Quod si

[1] Bacon's way of using the word "axioma" as if it were equivalent to "enuntiatum" or "propositio" he derived from Peter Ramus. Hasse, an early commentator on Ramus, remarks that the word is used in the same way by Cicero, who probably took it from the Stoics.

[2] Aristotle everywhere distinguishes between that which is prior and more known in the order of nature, and that which is prior and more known with respect to ourselves. Thus in the *Posterior Analytics*, i. 2., he says: "Priora autem et notiora dupliciter dicuntur: neque enim idem est prius naturâ et prius quantum ad nos pertinet; neque idem quod notius naturâ et quod nobis notius. Dico enim, quantum ad nos, et priora et notiora esse quæ a sensu propius; per se vero ac simpliciter, et priora et notiora quæ longius absunt; quo quid autem magis universale eo est remotius, ac singula quæque sunt proxima." The schoolmen, misled by the ambiguity of the Greek dative, substitute for "notius naturâ," τῇ φύσει γνωριμώτερον, "notius naturæ," as if Aristotle had spoken of Nature's knowledge in opposition to ours. The phrase in the text involves the same metaphor. It may be translated "Such as Nature would recognise as being really her first principles." "Notius naturâ" is equivalent to St. Thomas's expression "prius per viam perfectionis." See with respect to the subject of this uote, and especially to the origin and meaning of the phrases à priori and à posteriori, *Trendelenburg Elementa Log. Aristot.* 81.

Bartholdy's rendering is merely founded in error: "dass es die Natur für einen wirklichen Beweis einer innigern Bekanntschaft mit ihr anerkennen muss."

judicium illud vulgatum dialecticorum tam operosum fuerit, et tanta ingenia exercuerit; quanto magis laborandum est in hoc altero, quod non tantum ex mentis penetralibus, sed etiam ex naturæ visceribus extrahitur?

Neque tamen hic finis. Nam fundamenta quoque scientiarum fortius deprimimus et solidamus, atque initia inquirendi altius sumimus, quam adhuc homines fecerunt: ea subjiciendo examini, quæ logica vulgaris tanquam fide aliena recipit. Etenim dialectici principia scientiarum a scientiis singulis tanquam mutuo sumunt: rursus, notiones mentis primas venerantur: postremo, informationibus immediatis sensus bene dispositi acquiescunt. At nos logicam veram singulas scientiarum provincias majore cum imperio quam penes ipsarum principia sit debere ingredi decrevimus, atque illa ipsa principia putativa ad rationes reddendas compellere quousque plane constent.[1] Quod vero attinet ad notiones primas intellectus; nihil est eorum quæ intellectus sibi permissus congessit, quin nobis pro suspecto sit, nec ullo modo ratum, nisi novo judicio se stiterit et secundum illud pronuntiatum fuerit. Quinetiam sensus ipsius informationes multis modis excutimus. Sensus enim fallunt utique, sed et errores suos indicant: verum errores præsto, indicia eorum longe petita sunt.

Duplex autem est sensus culpa: aut enim destituit nos aut decipit. Nam primo, plurimæ sunt res quæ sensum etiam recte dispositum nec ullo modo impeditum effugiunt; aut subtilitate totius corporis, aut partium minutiis, aut loci distantia, aut tarditate atque etiam velocitate motus, aut familiaritate objecti, aut alias

[1] On the relation of philosophy to the sciences, I may refer to an interesting essay by Ritter in the *Berlin Transactions*.

ob causas. Neque rursus, ubi sensus rem tenet, prehensiones ejus admodum firmæ sunt. Nam testimonium et informatio sensus semper est ex analogia hominis, non ex analogia universi: [1] atque magno prorsus errore asseritur, sensum esse mensuram rerum.

Itaque ut his occurratur, nos multo et fido ministerio auxilia sensui undique conquisivimus et contraximus, ut destitutionibus substitutiones, variationibus rectificationes suppeditentur. Neque id molimur tam instrumentis quam experimentis. Etenim experimentorum longe major est subtilitas quam sensus ipsius, licet instrumentis exquisitis adjuti; (de iis loquimur experimentis, quæ ad intentionem ejus quod quæritur perite et secundum artem excogitata et apposita sunt.) [2] Itaque perceptioni sensus immediatæ ac propriæ non multum tribuimus: sed eo rem deducimus, ut sensus tantum de experimento, experimentum de re judicet. Quare existimamus nos sensus (a quo omnia in natu-

[1] The phrase "est ex analogiâ" is to be rendered (giving to "analogia" a wider signification than that which it ordinarily has) by "has reference to:" just as in the dictum, "materia non est cognoscibilis nisi ex analogiâ (or per analogiam) formæ;"—"except by reference to form." It seems not improbable that this way of using the word was suggested by the passage in the *Physics* which gave rise to the dictum I have quoted. Aristotle says, *Phys.* i. 7., "Ἡ δὲ ὑποκειμένη φύσις, ἐπιστητὴ κατὰ ἀναλογίαν — in which however the word is really used in its usual sense, since Aristotle goes on to say that this ὑποκειμένη φύσις stands in the same relation to οὐσία that bronze does to a statue, or wood to a couch; thus illustrating the nature of matter by referring to the subject-matter of an artificial form. Bacon elsewhere uses the phrase "in ordine ad" just as he here uses "ex analogiâ;" and on the other hand S. Thomas says, referring to the passage just cited, "Materia non est scibilis nisi *in ordine ad* formam, ut dicit Philosophus primo Physicorum;" so that the two phrases seem equivalent. See S. Thomas, *De Naturâ Materiæ*, c. 2., compared with the tract *De principio individuationis.*

That the meaning of the word Analogy was misconceived by S. Thomas, by Duns Scotus, and by the schoolmen in general, is pointed out by Zabarella, *De prim. rerum materiâ*, i. 4.

[2] [Compare *Nov. Org.* ii. 36.—*J. S.*]

ralibus petenda sunt, nisi forte libeat insanire) antistites religiosos, et oraculorum ejus non imperitos interpretes, nos præstitisse: ut alii professione quadam, nos re ipsa, sensum tueri ac colere videamur. Atque hujusmodi sunt ea quæ ad lumen ipsum naturæ ejusque accensionem et immissionem paramus: quæ per se sufficere possent, si intellectus humanus æqus et instar tabulæ abrasæ esset. Sed cum mentes hominum miris modis adeo obsessæ sint ut ad veros rerum radios excipiendos sincera et polita area prorsus desit, necessitas quædam incumbit ut etiam huic rei remedium quærendum esse putemus.

Idola autem a quibus occupatur mens, vel Adscititia sunt vel Innata. Adscititia vero immigrarunt in mentes hominum, vel ex philosophorum placitis et sectis vel ex perversis legibus demonstrationum. At Innata inhærent naturæ ipsius intellectus, qui ad errorem longe proclivior esse deprehenditur quam sensus. Utcunque enim homines sibi placeant et in admirationem mentis humanæ ac fere adorationem ruant, illud certissimum est: sicut speculum inæquale rerum radios ex figura et sectione propria immutat, ita et mentem, cum a rebus per sensum patitur, in notionibus suis expediendis et comminiscendis haud optima fide rerum naturæ suam naturam inserere et immiscere.

Atque priora illa duo *Idolorum* genera ægre, postrema vero hæc nullo modo, evelli possunt.[1] Id tantum relinquitur, ut indicentur, atque ut vis ista mentis insidiatrix notetur et convincatur; ne forte a destructione veterum novi subinde errorum surculi ex ipsa mala complexione mentis pullulent, eoque res recidat,

[1] The *priora duo* are the Idols of the Theatre, which include both kinds. The *postrema hæc* are the Idols of the Tribe, the Cave, and the Marketplace. Compare *De Aug. Sci.* v. 4.; and see Note C. at the end of the Prof. —*J. S.*

ut errores non extinguantur sed permutentur; verum e contra ut illud tandem in æternum ratum et fixum sit, intellectum nisi per inductionem ejusque formam legitimam judicare non posse. Itaque doctrina ista de expurgatione intellectus ut ipse ad veritatem habilis sit, tribus redargutionibus absolvitur: redargutione philosophiarum, redargutione demonstrationum, et redargutione rationis humanæ nativæ.[1] His vero explicatis, ac postquam demum patuerit quid rerum natura, quid mentis natura ferat, existimamus nos thalamum Mentis et Universi, pronuba divina bonitate, stravisse et ornasse. Epithalamii autem votum sit, ut ex eo connubio auxilia humana et stirps inventorum quæ necessitates ac miserias hominum aliqua ex parte doment et subigant, suscipiatur.[2] *Hæc vero est operis pars secunda.*

At vias non solum monstrare et munire, sed inire

[1] Compare Aph. 115, where these three *Redargutiones* are enumerated in the inverse order; in which order they are treated. This shows that the *Distributio Operis* was written before Bacon had decided upon the arrangement of the *Novum Organum*. See Note C. at the end of the Preface. — *J. S.*

[2] The received reading is *suscipiatur*, which seems erroneous, but may perhaps be defended. [I have myself very little doubt that Bacon wrote *suscipiatur*, not *suscipiantur*. If it be ever allowable to make a verb which depends upon two nominatives agree with the last only (which I think it sometimes is), there was a reason for doing so in this case; an ambiguity as well as a jingle being thereby avoided. In an earlier form of this passage (which will be found in the *Partis Instaurationis secundæ Delineatio*), the verb is in the singular, as here; though in that place it depends directly upon the plural nominative "auxilia humana," and therefore cannot be defended. In the *Redargutio Philosophiarum* it appears again in still another shape. There we have two nominatives, one singular and one plural, as here; but the plural coming last, the verb is in the plural, "ut ex illo connubio, non phantasiæ monstra, sed stirps heroum, quæ monstra domet et extinguat, — hoc est inventa salutaria et utilia ad necessitates humanas (quantum fieri datur) debellandos et relevandos, suscipiantur. Hoc epithalamii votum sit." — *J. S.*]

quoque consilium est. Itaque tertia pars operis complectitur *Phænomena Universi;* hoc est, omnigenam experientiam, atque historiam naturalem ejus generis quæ possit esse ad condendam philosophiam fundamentalis. Neque enim excellens aliqua demonstrandi via sive naturam interpretandi forma, ut mentem ab errore et lapsu defendere ac sustinere, ita ei materiam ad sciendum præbere et subministrare possit. Verum iis quibus non conjicere et hariolari, sed invenire et scire propositum est, quique non simiolas et fabulas mundorum comminisci, sed hujus ipsius veri mundi naturam introspicere et velut dissecare in animo habent, omnia a rebus ipsis petenda sunt. Neque huic labori et inquisitioni ac mundanæ perambulationi, ulla ingenii aut meditationis aut argumentationis substitutio aut compensatio sufficere potest; non si omnia omnium ingenia coierint. Itaque aut hoc prorsus habendum, aut negotium in perpetuum deserendum. Ad hunc vero usque diem ita cum hominibus actum est, ut minime mirum sit si natura sui copiam non faciat.

Nam primo, sensus ipsius informatio, et deserens et fallens; observatio, indiligens et inæqualis et tanquam fortuita; traditio, vana et ex rumore; practica, operi intenta et servilis; vis experimentalis, cæca, stupida, vaga, et prærupta; denique historia naturalis, levis et inops, vitiosissimam materiam intellectui ad philosophiam et scientias congesserunt.

Deinde, præpostera argumentandi subtilitas et ventilatio serum rebus plane desperatis tentatur remedium, nec negotium ullo modo restituit aut errores separat. Itaque nulla spes majoris augmenti ac progressus sita est, nisi in restauratione quadam scientiarum.

Hujus autem exordia omnino a naturali historia sumenda sunt, eaque ipsa novi cujusdam generis et apparatus. Frustra enim fuerit speculum expolire, si desint imagines; et plane materia idonea præparanda est intellectui, non solum præsidia fida comparanda. Differt vero rursus historia nostra (quemadmodum logica nostra) ab ea quæ habetur, multis rebus: fine sive officio, ipsa mole et congerie, dein subtilitate, etiam delectu et constitutione in ordine ad ea quæ sequuntur.

Primo enim eam proponimus historiam naturalem, quæ non tam aut rerum varietate delectet aut præsenti experimentorum fructu juvet, quam lucem inventioni causarum affundat, et philosophiæ enutricandæ primam mammam præbeat. Licet enim opera atque activam scientiarum partem præcipue sequamur, tamen messis tempus expectamus, nec muscum et segetem herbidam demetere conamur. Satis enim scimus, axiomata recte inventa tota agmina operum secum trahere, atque opera non sparsim sed confertim exhibere. Intempestivum autem illum et puerilem affectum, ut pignora aliqua novorum operum propere captentur, prorsus damnamus et amovemus, ceu pomum Atalantæ quod cursum retardat. Atque Historiæ nostræ Naturalis officium tale est.

Quoad congeriem vero, conficimus historiam non solum naturæ liberæ ac solutæ (cum scilicet illa sponte fluit et opus suum peragit), qualis est historia cœlestium, meteororum, terræ et maris, mineralium, plantarum, animalium; sed multo magis naturæ constrictæ et vexatæ; nempe, cum per artem et ministerium humanum de statu suo detruditur, atque premitur et fingitur. Itaque omnia artium mechanicarum, omnia

operativæ partis liberalium, omnia practicarum complurium quæ in artem propriam non coaluerunt, experimenta (quantum inquirere licuit et quantum ad finem nostrum faciunt) perscribimus. Quin etiam (ut quod res est eloquamur) fastum hominum et speciosa nil morati, multo plus et operæ et præsidii in hac parte quam in illa altera ponimus; quandoquidem natura rerum magis se prodit per vexationes artis quam in libertate propria.

Neque Corporum tantum historiam exhibemus; sed diligentiæ insuper nostræ esse putavimus, etiam Virtutum ipsarum (illarum dicimus quæ tanquam cardinales in natura censeri possint, et in quibus naturæ primordia plane constituuntur, utpote materiæ primis passionibus ac desideriis, viz. *Denso*, *Raro*, *Calido*, *Frigido*, *Consistenti*, *Fluido*, *Gravi*, *Levi*, aliisque haud paucis) historiam seorsum comparare.[1]

Enimvero ut de subtilitate dicamus, plane conquirimus genus experimentorum longe subtilius et simplicius quam sunt ea quæ occurrunt. Complura enim a tenebris educimus et eruimus, quæ nulli in mentem venisset investigare, nisi qui certo et constanti tramite ad inventionem causarum pergeret; cum in se nullius magnopere sint usus; ut liquido appareat, ea non propter se quæsita esse; sed ita prorsus se habeant illa ad res et opera quemadmodum literæ alphabeti se habeant ad orationem et verba; quæ licet per se inutiles eædem tamen omnis sermonis elementa sunt.

In delectu autem narrationum et experimentorum

[1] The whole tendency of Bacon's method led him to give the first place to inquiries relating to abstract qualities of the nature of those which he here mentions. We shall have occasion to remark on this point in connexion with several passages in the second book of the *Novum Organum*.

melius hominibus cavisse nos arbitramur quam qui adhuc in historia naturali versati sunt. Nam omnia fide oculata aut saltem perspecta, et summa quadam cum severitate, recipimus; ita ut nil referatur auctum miraculi causa, sed quæ narramus a fabulis et vanitate casta et intemerata sint. Quinetiam et recepta quæque ac jactata mendacia (quæ mirabili quodam neglectu per sæcula multa obtinuerunt et inveterata sunt) nominatim proscribimus et notamus; ne scientiis amplius molesta sint. Quod enim prudenter animadvertit quidam, fabulas et superstitiones et nugas quas nutriculæ pueris instillant, mentes eorum etiam serio depravare: ita eadem nos movit ratio ut solliciti atque etiam anxii simus ne ab initio, cum veluti infantiam philosophiæ sub historia naturali tractemus et curemus, illa alicui vanitati assuescat. At in omni experimento novo et paulo subtiliore, licet (ut nobis videtur) certo ac probato, modum tamen experimenti quo usi sumus aperte subjungimus; ut, postquam patefactum sit quomodo singula nobis constiterint, videant homines quid erroris subesse et adhærere possit, atque ad probationes magis fidas et magis exquisitas (si quæ sint) expergiscantur: denique ubique monita et scrupulos et cautiones aspergimus, religione quadam et tanquam exorcismo omnia phantasmata ejicientes ac cohibentes.

Postremo, cum nobis exploratum sit quantopere experientia et historia aciem mentis humanæ disgreget, et quam difficile sit (præsertim animis vel teneris vel præoccupatis) a principio cum natura consuescere, adjungimus sæpius observationes nostras, tanquam primas quasdam conversiones et inclinationes ac veluti aspectus historiæ ad philosophiam; ut et pignoris loco hominibus sint eos in historiæ fluctibus perpetuo non detentos

iri, utque cum ad opus intellectus deveniatur omnia sint magis in procinctu. Atque per hujusmodi (qualem describimus) Historiam Naturalem, aditum quendam fieri posse ad naturam tutum et commodum, atque materiam intellectui præberi probam et præparatam, censemus.

Postquam vero et intellectum fidissimis auxiliis ac præsidiis stipavimus, et justum divinorum operum exercitum severissimo delectu comparavimus; nil amplius superesse videtur, nisi ut philosophiam ipsam aggrediamur. Attamen in re tam ardua et suspensa, sunt quædam quæ necessario videntur interponenda; partim docendi gratia, partim in usum præsentem.

Horum primum est, ut exempla proponantur inquirendi et inveniendi secundum nostram rationem ac viam, in aliquibus subjectis repræsentata: sumendo ea potissimum subjecta quæ et inter ea quæ quæruntur sunt nobilissima et inter se maxime diversa; ut in unoquoque genere exemplum non desit. Neque de iis exemplis loquimur quæ singulis præceptis ac regulis illustrandi gratia adjiciuntur (hoc enim in secunda parte operis abunde præstitimus); sed plane typos intelligimus et plasmata, quæ universum mentis processum atque inveniendi continuatam fabricam et ordinem, in certis subjectis, iisque variis et insignibus, tanquam sub oculos ponant. Etenim nobis in mentem venit, in mathematicis, astante machina, sequi demonstrationem facilem et perspicuam; contra absque hac commoditate, omnia videri involuta et quam revera sunt subtiliora. Itaque hujusmodi exemplis quartam partem nostri operis attribuimus: quæ revera nil aliud est, quam secundæ partis applicatio particularis et explicata.

At quinta pars ad tempus tantum, donec reliqua perficiantur, adhibetur; et tanquam fœnus redditur, usque dum sors haberi possit. Neque enim finem nostrum ita petimus occæcati, ut quæ occurrunt in via utilia negligamus. Quamobrem quintam partem operis ex iis conficimus quæ a nobis aut inventa aut probata aut addita sunt; neque id tamen ex rationibus atque præscriptis interpretandi, sed ex eodem intellectus usu quem alii in inquirendo et inveniendo adhibere consueverunt. Etenim cum, ex perpetua nostra cum natura consuetudine, majora de meditationibus nostris quam pro ingenii viribus speramus; tum poterunt ista veluti tabernaculorum in via positorum vice fungi, ut mens ad certiora contendens in iis paulisper acquiescat. Attamen testamur interim, nos illis ipsis, quod ex vera interpretandi forma non sint inventa aut probata, teneri minime velle. Istam vero judicii suspensionem non est quod exhorreat quispiam, in doctrina quæ non simpliciter nil sciri posse, sed nil nisi certo ordine et certa via sciri posse, asserit; atque interea tamen certos certitudinis gradus ad usum et levamen constituit, donec mens in causarum explicatione consistat. Neque enim illæ ipsæ scholæ philosophorum qui *Acatalepsiam* simpliciter tenuerunt inferiores fuere istis quæ pronuntiandi licentiam usurparunt. Illæ tamen sensui et intellectui auxilia non paraverunt, quod nos fecimus, sed fidem et authoritatem plane sustulerunt; quod longe alia res est, et fere opposita.

Sexta tandem pars operis nostri (cui reliquæ inserviunt ac ministrant) eam demum recludit et proponit philosophiam, quæ ex hujusmodi (qualem ante docuimus et paravimus) inquisitione legitima et casta et

severa educitur et constituitur. Hanc vero postremam partem perficere et ad exitum perducere, res est et supra vires et ultra spes nostras collocata. Nos ei initia (ut speramus) non contemnenda, exitum generis humani fortuna dabit, qualem forte homines in hoc rerum et animorum statu haud facile animo capere aut metiri queant. Neque enim agitur solum fœlicitas contemplativa, sed vere res humanæ et fortunæ, atque omnis operum potentia. Homo enim naturæ minister et interpres tantum facit et intelligit, quantum de naturæ ordine, opere vel mente, observaverit : nec amplius scit, aut potest. Neque enim ullæ vires causarum catenam solvere aut perfringere possiut, neque natura aliter quam parendo vincitur. Itaque intentiones geminæ illæ, humanæ scilicet *Scientiæ* et *Potentiæ*, vere in idem coincidunt ; et frustratio operum maxime fit ex ignoratione causarum.

Atque in eo sunt omnia, siquis oculos mentis a rebus ipsis nunquam dejiciens, earum imagines plane ut sunt excipiat. Neque enim hoc siverit Deus, ut phantasiæ nostræ somnium pro exemplari mundi edamus : sed potius benigne faveat, ut apocalypsim ac veram visionem vestigiorum [1] et sigillorum creatoris super creaturas scribamus.

Itaque Tu Pater, qui lucem visibilem primitias creaturæ dedisti, et lucem intellectualem ad fastigium operum tuorum in faciem hominis inspirasti ; opus hoc, quod a tua bonitate profectum tuam gloriam repetit, tuere et rege. Tu postquam conversus es ad spectandum opera

[1] This application of the word "vestigia" is constantly made by the schoolmen. Thus St. Thomas Aquinas : "In rationalibus creaturis est imago Trinitatis, in cæteris vero creaturis est *vestigium* Trinitatis, in quantum in eis inveniuntur aliqua quæ reducuntur in divinas personas." — *Summa Theolog.* 1ma pars, q. 45. art. 7.

quæ fecerunt manus tuæ, vidisti quod omnia essent bona valde; et requievisti. At homo conversus ad opera quæ fecerunt manus suæ, vidit quod omnia essent vanitas et vexatio spiritus; nec ullo modo requievit. Quare si in operibus tuis sudabimus, facies nos visionis tuæ et sabbati tui participes.[1] Supplices petimus, ut hæc mens nobis constet; utque novis eleemosynis, per manus nostras et aliorum quibus eandem mentem largieris, familiam humanam dotatam velis.

[1] Compare this with St. Augustine's prayer at the close of the *Confessions*. "Domine Deus pacem da nobis (omnia enim præstitisti nobis), pacem quietis, pacem Sabbati, Sabbati sine vesperâ. Omnis quippe iste ordo pulcherrimus rerum valde bonarum modis suis peractis transiturus est, et mane quippe in eis factum est et vespera. Dies autem septimus sine vesperâ est, nec habet occasum, quia sanctificasti eum ad permansionem sempiternam, ut id quod tu post opera tua bona valde, quamvis ea quietus feceris, requievisti septimo die, hoc præloquatur nobis vox libri tui, quod et nos post opera nostra, ideo bona valde quia tu nobis ea donasti, sabbato vitæ æternæ requiescamus in te." — *Conf.* xiii. 35—6.

Compare also the line with which the *Faerie Queene* breaks off: —

"O that [q. thou?] great Sabbaoth God graunt me that Sabbaoth sight."

DEEST

PARS PRIMA INSTAURATIONIS,

QUÆ COMPLECTITUR

PARTITIONES SCIENTIARUM.

Illæ tamen ex Secundo Libro de Progressibus faciendis in Doctrina Divina et Humana, *nonnulla ex parte peti possunt.*[1]

SEQUITUR

SECUNDA PARS INSTAURATIONIS,

QUÆ ARTEM IPSAM

Interpretandi Naturam, et verioris adoperationis Intellectus exhibet: neque eam ipsam tamen in Corpore tractatus justi, sed tantum digestam per summas, in Aphorismos.[2]

[1] This is omitted in the common editions of Bacon's collected works (in all, I believe, except Montagu's); the *De Augmentis Scientiarum*, with the title "*Instaurationis Magnæ pars prima*" prefixed on a separate leaf, being

[2] This explains a certain discrepancy between the design of the second part, as set forth in the *Distributio Operis*, and the execution of it in the *Novum Organum*. The *Distributio*, like the *Delineatio*, was probably written when Bacon intended to work it out in a regular and consecutive treatise, and represents the *idea* of the work more perfectly than the work itself. See note on Distr. Op. p. 220. —*J. S.*

substituted for it. And it is true that Bacon did afterwards decide upon supplying this deficiency by a translation of the *Advancement of Learning* enlarged; that he produced the *De Augmentis Scientiarum* with that intention and understanding; and that though the original edition does not bear "*Instaurationis Magnæ pars prima*" on the titlepage, yet in Dr. Rawley's reprint of it in 1638 those words were inserted. Nevertheless this notice is of importance, as showing that when Bacon published the *Novum Organum* he did not look to a mere *enlargement* of the *Advancement of Learning* as satisfying the intention of the *pars prima;* for if he had, he would have referred to the work itself, not to the second book only. He meant, no doubt, to reproduce the substance of it in a different form. And my own impression is that the *Descriptio Globi Intellectualis* was originally designed for this place, and that he had not yet abandoned the hope of completing it; but that soon after,—fortune gone, health shaken, assistance not to be commanded, and things of more importance remaining to be done,—he found he had not time to finish it on so large a scale, and therefore resolved to enlarge the old house instead of building a new one. — *J. S.*

PARS SECUNDA OPERIS,

QUÆ DICITUR

NOVUM ORGANUM,

SIVE

INDICIA VERA

DE INTERPRETATIONE NATURÆ.

PRÆFATIO.

Qui de natura tanquam de re explorata pronuntiare ausi sunt, sive hoc ex animi fiducia fecerint sive ambitiose et more professorio, maximis illi philosophiam et scientias detrimentis affecere. Ut enim ad fidem faciendam validi, ita etiam ad inquisitionem extinguendam et abrumpendam efficaces fuerunt. Neque virtute propria tantum profuerunt, quantum in hoc nocuerunt, quod aliorum virtutem corruperint et perdiderint. Qui autem contrariam huic viam ingressi sunt atque nihil prorsus sciri posse asseruerunt, sive ex sophistarum veterum odio sive ex animi fluctuatione aut etiam ex quadam doctrinæ copia in hanc opinionem delapsi sint, certe non contemnendas ejus rationes adduxerunt; veruntamen nec a veris initiis sententiam suam derivarunt, et studio quodam atque affectatione provecti, prorsus modum excesserunt. At antiquiores ex Græcis (quorum scripta perierunt) inter pronuntiandi jactantiam et *Acatalepsiæ* desperationem prudentius se sustinuerunt: atque de inquisitionis difficultate et rerum obscuritate sæpius querimonias et indignationes miscentes, et veluti frænum mordentes, tamen propositum urgere atque naturæ se immiscere non destiterunt; consentaneum (ut videtur) existimantes, hoc ipsum (videlicet utrum aliquid sciri possit) non disputare,

sed experiri. Et tamen illi ipsi, impetu tantum intellectus usi, regulam non adhibuerunt, sed omnia in acri meditatione et mentis volutatione et agitatione perpetua posuerunt.

Nostra autem ratio, ut opere ardua, ita dictu facilis est. Ea enim est, ut certitudinis gradus constituamus, sensum per reductionem quandam tueamur,[1] sed mentis opus quod sensum subsequitur plerunque rejiciamus; novam autem et certam viam, ab ipsis sensuum perceptionibus, menti aperiamus et muniamus. Atque hoc proculdubio viderunt et illi qui tantas dialecticæ partes tribuerunt. Ex quo liquet, illos intellectui adminicula quæsivisse, mentis autem processum nativum et sponte moventem, suspectum habuisse. Sed serum plane rebus perditis hoc adhibetur remedium; postquam mens ex quotidiana vitæ consuetudine, et auditionibus et doctrinis inquinatis occupata, et vanissimis *idolis* obsessa fuerit. Itaque ars illa dialecticæ, sero (ut diximus) cavens neque rem ullo modo restituens, ad errores potius figendos quam ad veritatem aperiendam valuit. Restat unica salus ac sanitas, ut opus mentis universum de integro resumatur; ac mens, jam ab ipso principio, nullo modo sibi permittatur, sed perpetuo regatur; ac res veluti per machinas conficiatur. Sane si homines opera mechanica nudis manibus, absque instrumentorum vi et ope, aggressi essent, quemadmodum opera intellectualia nudis fere mentis viribus tractare

[1] The word "reductio" appears to be used much as in modern scientific language; that is, as nearly equivalent to correction; — as when we speak of *reducing* observations, &c., by which is meant the applying to them of certain principles of correction: I should translate the clause in which it occurs by "we guard the sense from error by a certain method of correction;" — a translation which accords with what is said infra, I. 69., with respect to the short-comings and errors of the senses.

non dubitarunt, parvæ admodum fuissent res quas movere et vincere potuissent, licet operas enixas atque etiam conjunctas præstitissent. Atque si paulisper morari, atque in hoc ipsum exemplum, veluti in speculum, intueri velimus; exquiramus (si placet) si forte obeliscus aliquis magnitudine insignis ad triumphi vel hujusmodi magnificentiæ decus transferendus esset, atque id homines nudis manibus aggrederentur, annon hoc magnæ cujusdam esse dementiæ spectator quispiam rei sobrius fateretur? Quod si numerum augerent operariorum, atque hoc modo se valere posse confiderent, annon tanto magis? Sin autem delectum quendam adhibere vellent, atque imbecilliores separare, et robustis tantum et vigentibus uti, atque hinc saltem se voti compotes fore sperarent, annon adhuc eos impensius delirare diceret? Quin etiam si hoc ipso non contenti, artem tandem athleticam consulere statuerent, ac omnes deinceps manibus et lacertis et nervis ex arte bene unctis et medicatis adesse juberent, annon prorsus eos dare operam ut cum ratione quadam et prudentia insanirent, clamaret? Atque homines tamen simili malesano impetu et conspiratione inutili feruntur in intellectualibus; dum ab ingeniorum vel multitudine et consensu vel excellentia et acumine magna sperant, aut etiam dialectica (quæ quædam athletica censeri possit) mentis nervos roborant; sed interim, licet tanto studio et conatu, (si quis vere judicaverit) intellectum nudum applicare non desinunt. Manifestissimum autem est, in omni opere magno, quod manus hominis præstat, sine instrumentis et machinis, vires nec singulorum intendi nec omnium coire posse.

Itaque ex his quæ diximus præmissis, statuimus duas esse res de quibus homines plane monitos volumus, ne

forte illæ eos fugiant aut prætereant. Quarum prima hujusmodi est; fieri fato quodam (ut existimamus) bono, ad extinguendas et depellendas contradictiones et tumores animorum, ut et veteribus honor et reverentia intacta et imminuta maneant, et nos destinata perficere et tamen modestiæ nostræ fructum percipere possimus. Nam nos, si profiteamur nos meliora afferre quam antiqui, eandem quam illi viam ingressi, nulla verborum arte efficere possimus, quin inducatur quædam ingenii vel excellentiæ vel facultatis comparatio sive contentio; non ea quidem illicita aut nova; — quidni enim possimus pro jure nostro (neque eo ipso alio, quam omnium) si quid apud eos non recte inventum aut positum sit, reprehendere aut notare? — sed tamen utcunque justa aut permissa, nihilominus impar fortasse fuisset ea ipsa contentio, ob virium nostrarum modum. Verum quum per nos illud agatur, ut alia omnino via intellectui aperiatur illis intentata et incognita, commutata jam ratio est; cessant studium et partes; nosque indicis tantummodo personam sustinemus, quod mediocris certe est authoritatis, et fortunæ cujusdam potius quam facultatis et excellentiæ. Atque hæc moniti species ad personas pertinet; altera ad res ipsas.

Nos siquidem de deturbanda ea quæ nunc floret philosophia, aut si quæ alia sit aut erit hac emendatior aut auctior, minime laboramus. Neque enim officimus, quin philosophia ista recepta, et aliæ id genus, disputationes alant, sermones ornent, ad professoria munera et vitæ civilis compendia adhibeantur et valeant. Quin etiam aperte significamus et declaramus, eam quam nos adducimus philosophiam ad istas res admodum utilem non futuram. Non præsto est, neque in transitu

capitur, neque ex prænotionibus intellectui blanditur, neque ad vulgi captum nisi per utilitatem et effecta descendet.

Sint itaque (quod fœlix faustumque sit utrique parti) duæ doctrinarum emanationes, ac duæ dispensationes; duæ similiter contemplantium sive philosophantium tribus ac veluti cognationes; atque illæ neutiquam inter se inimicæ aut alienæ, sed fœderatæ et mutuis auxiliis devinctæ: sit denique alia scientias colendi, alia inveniendi ratio. Atque quibus prima potior et acceptior est, ob festinationem, vel vitæ civilis rationes, vel quod illam alteram ob mentis infirmitatem capere et complecti non possint (id quod longe plurimis accidere necesse est), optamus ut iis fœliciter et ex voto succedat quod agunt, atque ut quod sequuntur teneant. Quod si cui mortalium cordi et curæ sit, non tantum inventis hærere atque iis uti, sed ad ulteriora penetrare; atque non disputando adversarium, sed opere naturam vincere; denique, non belle et probabiliter opinari, sed certo et ostensive scire; tales, tanquam veri scientiarum filii, nobis (si videbitur) se adjungant; ut omissis naturæ atriis, quæ infiniti contriverunt, aditus aliquando ad interiora patefiat. Atque ut melius intelligamur, utque illud ipsum quod volumus ex nominibus impositis magis familiariter occurrat, altera ratio sive via *Anticipatio Mentis*, altera *Interpretatio Naturæ*, a nobis appellari consuevit.

Est etiam quod petendum videtur. Nos certe cogitationem suscepimus et curam adhibuimus, ut quæ a nobis proponentur non tantum vera essent, sed etiam ad animos hominum (licet miris modis occupatos et interclusos) non incommode aut aspere accederent. Veruntamen æquum est, ut ab hominibus impetremus

(in tanta præsertim doctrinarum et scientiarum restauratione) ut qui de hisce nostris aliquid, sive ex sensu proprio, sive ex authoritatum turba, sive ex demonstrationum formis (quæ nunc tanquam leges quædam judiciales invaluerunt), statuere aut existimare velit, ne id in transitu et velut aliud agendo facere se posse speret; sed ut rem pernoscat; nostram, quam describimus et munimus, viam ipse paullatim tentet; subtilitati rerum quæ in experientia signata est assuescat; pravos denique atque alte hærentes mentis habitus tempestiva et quasi legitima mora corrigat; atque tum demum (si placuerit) postquam in potestate sua esse cœperit, judicio suo ùtatur.

SEQUITUR

PARTIS SECUNDÆ SUMMA,

DIGESTA

IN APHORISMOS.

PARTIS SECUNDÆ SUMMA,

DIGESTA IN

APHORISMOS.

APHORISMI

DE INTERPRETATIONE NATURÆ

ET REGNO HOMINIS.

Aphorismus

I.

Homo, Naturæ minister[1] et interpres, tantum facit et intelligit quantum de Naturæ ordine re vel mente observaverit, nec amplius scit aut potest.

II.

Nec manus nuda nec intellectus sibi permissus multum valet; instrumentis et auxiliis res perficitur; quibus opus est non minus ad intellectum quam ad manum. Atque ut instrumenta manus motum aut cient aut regunt, ita et instrumenta mentis intellectui aut suggerunt aut cavent.

III.

Scientia et potentia humana in idem coincidunt, quia ignoratio causæ destituit effectum. Natura enim non nisi parendo vincitur;[2] et quod in contemplatione instar causæ est, id in operatione instar regulæ est.

[1] That the physician is "naturæ minister," φύσεως ὑπηρέτης, is quoted more than once from Hippocrates by Galen, xv. 369. xvi. 35. (Kuhn): the first passage in his commentary on Hippoc. *De Aliment.* iii., the second in his do. *De Humor.* i.

[2] This antithesis was probably suggested by Publius Syrus's gnome:— "Casta ad virum matrona parendo imperat."

IV.

Ad opera nil aliud potest homo, quam ut corpora naturalia admoveat et amoveat; reliqua Natura intus transigit.[1]

V.

Solent se immiscere naturæ (quoad opera) mechanicus, mathematicus, medicus, alchymista, et magus; sed omnes (ut nunc sunt res) conatu levi, successu tenui.

VI.

Insanum quiddam esset, et in se contrarium, existimare ea quæ adhuc nunquam facta sunt fieri posse, nisi per modos adhuc nunquam tentatos.

VII.

Generationes mentis et manus numerosæ admodum videntur in libris et opificiis. Sed omnis ista varietas sita est in subtilitate eximia, et derivationibus paucarum rerum quæ innotuerunt; non in numero Axiomatum.

VIII.

Etiam opera, quæ jam inventa sunt, casui debentur et experientiæ magis quam scientiis: scientiæ enim, quas nunc habemus, nihil aliud sunt quam quædam concinnationes rerum antea inventarum; non modi inveniendi, aut designationes novorum operum.

IX.

Causa vero et radix fere omnium malorum in scientiis ea una est; quod dum mentis humanæ vires falso

[1] For some remarks upon the first four Aphorisms, see the Preface, p. 156.—*J. S.*

miramur et extollimus, vera ejus auxilia non quæramus.

X.

Subtilitas naturæ subtilitatem sensus et intellectus multis partibus superat; ut pulchræ illæ meditationes et speculationes humanæ et causationes res male-sana sint, nisi quod non adsit qui advertat.[1]

XI.

Sicut scientiæ quæ nunc habentur inutiles sunt ad inventionem operum; ita et logica quæ nunc habetur inutilis est ad inventionem scientiarum.

XII.

Logica quæ in usu est ad errores (qui in notionibus vulgaribus fundantur) stabiliendos et figendos valet, potius quam ad inquisitionem veritatis; ut magis damnosa sit quam utilis.

XIII.

Syllogismus ad principia scientiarum non adhibetur, ad media axiomata frustra adhibetur, cum sit subtilitati naturæ longe impar. Assensum itaque constringit, non res.

XIV.

Syllogismus ex propositionibus constat, propositiones ex verbis, verba notionum tesseræ sunt. Itaque si notiones ipsæ (id quod basis rei est) confusæ sint et temere a rebus abstractæ, nihil in iis quæ superstruuntur est firmitudinis. Itaque spes est una in *inductione* vera.

[1] That is, they must from the nature of the case be so far from the truth, that, if we could but compare them with the reality, they would seem like the work of men not in their senses. —*J. S.*

XV.

In notionibus nil sani est, nec in logicis nec in physicis; non *Substantia*, non *Qualitas*, *Agere*, *Pati*, ipsum *Esse*, bonæ notiones sunt; multo minus *Grave*, *Leve*, *Densum*, *Tenue*, *Humidum*, *Siccum*, *Generatio*, *Corruptio*, *Attrahere*, *Fugare*, *Elementum*, *Materia*, *Forma*, et d genus; sed omnes phantasticæ et male terminatæ.

XVI.

Notiones infimarum specierum, *Hominis*, *Canis*, *Columbæ*, et prehensionum immediatarum sensus, *Calidi*, *Frigidi*, *Albi*, *Nigri*, non fallunt magnopere; quæ tamen ipsæ a fluxu materiæ et commistione[1] rerum quandoque confunduntur; reliquæ omnes (quibus homines hactenus usi sunt) aberrationes sunt, nec debitis modis a rebus abstractæ et excitatæ.

XVII.

Nec minor est libido et aberratio in constituendis axiomatibus, quam in notionibus abstrahendis; idque in ipsis principiis, quæ ab inductione vulgari pendent. At multo major est in axiomatibus et propositionibus inferioribus, quæ educit syllogismus.

XVIII.

Quæ adhuc inventa sunt in scientiis, ea hujusmodi sunt ut notionibus vulgaribus fere subjaceant; ut vero

[1] [*Commissione* in the original edition. — *J. S.*] From the context it is clear that Bacon means that the union of bodies of different kinds, by giving rise to new qualities and species intermediate to those for which we have recognised names, tends to confuse our ideas of the latter. I think therefore we ought to read "commistione" for "commissione." [The word *commistio* is used elsewhere by Bacon; see for instance II. 13. § 34. — *J. S.*]

ad interiora et remotiora naturæ penetretur, necesse est ut tam notiones quam axiomata magis certa et munita via a rebus abstrahantur; atque omnino melior et certior intellectus adoperatio in usum veniat.

XIX.

Duæ viæ sunt, atque esse possunt, ad inquirendam et inveniendam veritatem. Altera a sensu et particularibus advolat ad axiomata maxime generalia, atque ex iis principiis eorumque immota veritate judicat et invenit axiomata media; atque hæc via in usu est: altera a sensu et particularibus excitat axiomata, ascendendo continenter et gradatim, ut ultimo loco perveniatur ad maxime generalia; quæ via vera est, sed intentata.

XX.

Eandem ingreditur viam (priorem scilicet) intellectus sibi permissus, quam facit ex ordine dialecticæ. Gestit enim mens exilire ad magis generalia, ut acquiescat; et post parvam moram fastidit experientiam. Sed hæc mala demum aucta sunt a dialectica, ob pompas disputationum.

XXI.

Intellectus sibi permissus, in ingenio sobrio et patiente et gravi (præsertim si a doctrinis receptis non impediatur), tentat nonnihil illam alteram viam, quæ recta est, sed exiguo profectu; cum intellectus, nisi regatur et juvetur, res inæqualis sit, et omnino inhabilis ad superandam rerum obscuritatem.[1]

[1] I should be inclined to translate this clause, "since the intellect, if it be not guided and assisted, *acts irregularly* (res inæqualis sit), and is altogether unequal to overcoming the obscurity of nature." Thus in § 60. we meet with a similar use of the adverb "*inæqualiter:*"—"temere et

XXII.

Utraque via orditur a sensu et particularibus, et acquiescit in maxime generalibus; sed immensum quiddam discrepant; cum altera perstringat tantum experientiam et particularia cursim, altera in iis rite et ordine versetur; altera rursus jam a principio constituat generalia quædam abstracta et inutilia, altera gradatim exurgat ad ea quæ revera naturæ sunt notiora.[1]

XXIII.

Non leve quiddam interest inter humanæ mentis *idola* et divinæ mentis ideas; hoc est, inter placita quædam inania et veras signaturas[2] atque impressiones factas in creaturis, prout inveniuntur.

XXIV.

Nullo modo fieri potest, ut axiomata per argumen-

inæqualiter a rebus abstracta"—"rashly and irregularly abstracted from their objects." Or perhaps, though this translation would not be free from objection, inæqualis might be rendered "inadequate" or unequal to the matter in hand.

[1] This phrase is a scholastic mistranslation of the Aristotelian phrase τῇ φύσει γνωριμώτερον· *i. e.* naturally better known, or naturally better fitted to be the object of knowledge. It is difficult to render the phrase accurately either into Latin or into English, because in neither language is there an adjective corresponding to the Greek γνώριμος; "notus" and "known" being of course participles, and immediately suggesting the question, "known to whom?" [See note on Distrib. Operis, p. 216. In his English writings, Bacon seems to use the word "original" as equivalent to "naturæ notius." Compare the instruction for "freeing a direction," in the *Valerius Terminus*, with the "præceptum verum et perfectum operandi," in the *Nov. Org.* ii. 4.; where the rule that "the nature discovered be *more original* than the nature supposed and not more secondary or of the like degree," in the one, corresponds with the precept "Forma vera talis sit ut naturam datam ex fonte aliquo essentiæ deducat, quæ inest pluribus et *notior est naturæ* (ut loquuntur) quam ipsa forma," in the other. — *J. S.*]

[2] See note on Distr. Op. p. 227. — *J. S.*

tationem constituta ad inventionem novorum operum valeant; quia subtilitas naturæ subtilitatem argumentandi multis partibus superat. Sed axiomata a particularibus rite et ordine abstracta nova particularia rursus facile indicant et designant; itaque scientias reddunt activas.

XXV.

Axiomata quæ in usu sunt ex tenui et manipulari experientia et paucis particularibus, quæ ut plurimum occurrunt, fluxere; et sunt fere ad mensuram eorum facta et extensa: ut nil mirum sit, si ad nova particularia non ducant. Quod si forte instantia aliqua non prius animadversa aut cognita se offerat, axioma distinctione aliqua frivola salvatur, ubi emendari ipsum verius foret.

XXVI.

Rationem humanam qua utimur ad naturam, *Anticipationes Naturæ* (quia res temeraria est et præmatura), at illam rationem quæ debitis modis elicitur a rebus, *Interpretationem Naturæ*, docendi gratia vocare consuevimus.

XXVII.

Anticipationes satis firmæ sunt ad consensum; quandoquidem si homines etiam insanirent ad unum modum et conformiter, illi satis bene inter se congruere possent.

XXVIII.

Quin longe validiores sunt ad subeundum assensum Anticipationes quam Interpretationes; quia ex paucis collectæ, iisque maxime quæ familiariter occurrunt, intellectum statim perstringunt et phantasiam implent: ubi contra Interpretationes, ex rebus admodum variis et multum distantibus sparsim collectæ, intellectum subito

percutere non possunt; ut necesse sit eas, quoad opiniones, duras et absonas, fere instar mysteriorum fidei, videri.

XXIX.

In scientiis quæ in opinionibus et placitis fundatæ sunt, bonus est usus Anticipationum et Dialecticæ; quando opus est assensum subjugare, non res.

XXX.

Non, si omnia omnium ætatum ingenia coierint et labores contulerint et transmiserint, progressus magnus fieri poterit in scientiis per Anticipationes; quia errores radicales, et in prima digestione mentis, ab excellentia functionum et remediorum sequentium non curantur.

XXXI.

Frustra magnum expectatur augmentum in scientiis ex superinductione et insitione novorum super vetera; sed instauratio facienda est ab imis fundamentis, nisi libeat perpetuo circumvolvi in orbem, cum exili et quasi contemnendo progressu.

XXXII.

Antiquis authoribus suus constat honos, atque adeo omnibus; quia non ingeniorum aut facultatum inducitur comparatio, sed viæ; nosque non judicis sed indicis personam sustinemus.

XXXIII.

Nullum (dicendum enim est aperte) recte fieri potest judicium nec de via nostra, nec de iis quæ secundum eam inventa sunt, per Anticipationes (rationem scilicet quæ in usu est); quia non postulandum est

ut ejus rei judicio stetur, quæ ipsa in judicium vocatur.

XXXIV.

Neque etiam tradendi aut explicandi ea quæ adducimus facilis est ratio; quia quæ in se nova sunt intelligentur tamen ex analogia veterum.[1]

XXXV.

Dixit Borgia de expeditione Gallorum in Italiam, eos venisse cum creta in manibus ut diversoria notarent, non cum armis ut perrumperent:[2] itidem et nostra ratio est, ut doctrina nostra animos idoneos et capaces subintret; confutationum enim nullus est usus, ubi de principiis et ipsis notionibus, atque etiam de formis demonstrationum, dissentimus.

XXXVI.

Restat vero nobis modus tradendi unus et simplex, ut homines ad ipsa particularia et eorum series et ordines adducamus; et ut illi rursus imperent sibi ad tempus abnegationem Notionum, et cum rebus ipsis consuescere incipiant.

[1] For the meaning of "analogia" see note on the Distr. Op. p. 218. — *J. S.*

[2] "Diceva in quei tempi Papa Alessandro sesto che i Francesi havevano corso l'Italia con gli speroni di legno et presola col gesso: dicendo così perchè pigliando essi gli alloggiamenti nelle città loro furieri segnavano le porte delle case col gesso; et cavalcando per loro diporto i gentil' huomini per le terre à sollazzo usavano di portare nelle scarpette à calcagni certi stecchi di legno appuntati, delli quali in vece di speroni si servivano per andare le cavalcature." — *Nardi, Vita di Malespini*, [1597,] p. 18.

In an epitome of the history of Charles the Eighth, which will be found in the "Archives curieuses" of Cember, vol. i. p. 197., and which was apparently written about the beginning of the seventeenth century, the remark ascribed to Alexander the Sixth by Nardi and Bacon is mentioned as a popular saying.

XXXVII.

Ratio eorum qui *acatalepsiam* tenuerunt, et via nostra, initiis suis quodammodo consentiunt; exitu immensum disjunguntur et opponuntur. Illi enim nihil sciri posse simpliciter asserunt; nos non multum sciri posse in natura, ea quæ nunc in usu est via: verum illi exinde authoritatem sensus et intellectus destruunt; nos auxilia iisdem excogitamus et subministramus.

XXXVIII.

Idola et notiones falsæ quæ intellectum humanum jam occuparunt atque in eo alte hærent, non solum mentes hominum ita obsident ut veritati aditus difficilis pateat; sed etiam dato et concesso aditu, illa rursus in ipsa instauratione scientiarum occurrent et molesta erunt, nisi homines præmoniti adversus ea se quantum fieri potest muniant.

XXXIX.

Quatuor sunt genera Idolorum quæ mentes humanas obsident. Iis (docendi gratia) nomina imposuimus; ut primum genus, Idola Tribus; secundum, Idola Specus; tertium, Idola Fori; quartum, Idola Theatri vocentur.[1]

[1] These four idols have been compared to the four hindrances to truth enumerated by Roger Bacon. These are, the use of insufficient authority, custom, popular opinions, and the concealment of ignorance and display of apparent knowledge. The last two may be likened to the idols of the market-place and the theatre. But the principle of the classification is different. [See on this subject the Preface, p. 159. Roger Bacon's words are as follows:—

"Quatuor vero maxima sunt comprehendendæ veritatis offendicula, quæ omnem quemcunque sapientem impediunt, et vix aliquem permittunt ad verum titulum sapientiæ pervenire: viz. fragilis et indignæ auctoritatis ex-

XL.

Excitatio Notionum et Axiomatum per Inductionem veram, est certe proprium remedium ad Idola arcenda et summovenda; sed tamen indicatio Idolorum magni est usus. Doctrina enim de Idolis similiter se habet ad Interpretationem Naturæ, sicut doctrina de Sophisticis Elenchis ad Dialecticam vulgarem.

XLI.

Idola Tribus sunt fundata in ipsa natura humana, atque in ipsa tribu seu gente hominum. Falso enim asseritur, sensum humanum esse mensuram rerum;[1] quin contra, omnes perceptiones tam sensus quam mentis sunt ex analogia hominis, non ex analogia universi. Estque intellectus humanus instar speculi inæqualis ad radios rerum, qui suam naturam naturæ rerum immiscet, eamque distorquet et inficit.

XLII.

Idola Specus sunt idola hominis individui. Habet enim unusquisque (præter aberrationes naturæ humanæ in genere) specum sive cavernam quandam individuam, quæ lumen naturæ frangit et corrumpit;

emplum, consuetudinis diuturnitas, vulgi sensus imperiti, et propriæ ignorantiæ occultatio cum ostentatione sapientiæ apparentis. His omnis homo involvitur, omnis status occupatur. Nam quilibet singulis artibus vitæ et studii et omnis negotii tribus pessimis ad eandem conclusionem utitur argumentis: scil. hoc exemplificatum est per majores, hoc consuetum est, hoc vulgatum est, ergo tenendum. . . . . Si vero hæc tria refellantur aliquando magnificâ rationis potentiâ, quartum semper in promptu est et in ore cujuslibet, ut quilibet ignorantiam suam excuset, et licet nihil dignum sciat illud tamen magnificet imprudenter [impudenter?] et sic saltem suæ stultitiæ infelici solatio veritatem opprimat et eliat." — *Opus Majus*, l. i. — *J. S.*]

[1] Protagoras. See Hippias Major.

vel propter naturam cujusque propriam et singularem; vel propter educationem et conversationem cum aliis; vel propter lectionem librorum, et authoritates eorum quos quisque colit et miratur; vel propter differentias impressionum, prout occurrunt in animo præoccupato et prædisposito aut in animo æquo et sedato, vel ejusmodi; ut plane spiritus humanus (prout disponitur in hominibus singulis) sit res varia, et omnino perturbata, et quasi fortuita: unde bene Heraclitus, homines scientias quærere in minoribus mundis, et non in majore sive communi.[1]

XLIII.

Sunt etiam Idola tanquam ex contractu et societate humani generis ad invicem, quæ Idola Fori, propter hominum commercium et consortium, appellamus. Homines enim per sermones sociantur; at verba ex captu vulgi imponuntur. Itaque mala et inepta verborum impositio miris modis intellectum obsidet. Neque definitiones aut explicationes, quibus homines docti se munire et vindicare in nonnullis consueverunt, rem ullo modo restituunt. Sed verba plane vim faciunt intellectui, et omnia turbant; et homines ad inanes et innumeras controversias et commenta deducunt.

XLIV.

Sunt denique Idola quæ immigrarunt in animos hominum ex diversis dogmatibus philosophiarum, ac etiam ex perversis legibus demonstrationum; quæ Idola Theatri nominamus; quia quot philosophiæ receptæ aut inventæ sunt, tot fabulas productas et

[1] See Sextus Empiricus, *Adversus Logicos*, i. § 133.; and compare ii. § 186. of the same treatise.

actas censemus, quæ mundos effecerunt fictitios et scenicos. Neque de his quæ jam habentur, aut etiam de veteribus philosophiis et sectis, tantum loquimur; cum complures aliæ ejusmodi fabulæ componi et concinnari possint; quandoquidem errorum prorsus diversorum causæ sint nihilominus fere communes. Neque rursus de philosophiis universalibus tantum hoc intelligimus, sed etiam de principiis et axiomatibus compluribus scientiarum, quæ ex traditione et fide et neglectu invaluerunt. Verum de singulis istis generibus idolorum fusius et distinctius dicendum est, ut intellectui humano cautum sit.

XLV.[1]

Intellectus humanus ex proprietate sua[2] facile supponit majorem ordinem et æqualitatem in rebus quam invenit; et cum multa sint in natura monodica[3] et plena imparitatis, tamen affingit parallela et correspondentia et relativa quæ non sunt. Hinc commenta illa, *in cœlestibus omnia moveri per circulos perfectos*, lineis spiralibus et draconibus[4] (nisi nomine tenus)

[1] Here, according to the tripartite distribution of the "Pars Destruens" mentioned in the 115th aphorism, begins the first Redargutio — Redargutio Rationis Humanæ Nativæ. — *J. S.*

[2] That is "in accordance with the homogeneity of its own substance," or as Bacon expresses it in § 52., "ex æqualitate substantiæ spiritus humani."

[3] The word which Bacon intends to use is, of course, "monadica;" but throughout his writings he has fallen into the error of which the text affords an instance.

[4] It does not appear in what sense Bacon uses the word "draco." In its ordinary acceptation in old astronomy, it denoted the great circle which is approximately the projection on the sphere of the moon's orbit. The ascending node was called the caput draconis, and the descending the cauda draconis. The same terms were occasionally applied to the nodes of the planetary orbits. It is not improbable that Bacon intended to complain of the rejection of spirals of double curvature, or helices, which traced on the

prorsus rejectis. Hinc elementum ignis cum orbe suo introductum est, ad constituendam quaternionem cum reliquis tribus, quæ subjiciuntur sensui.[1] Etiam elementis (quæ vocant) imponitur ad placitum decupla proportio excessus in raritate ad invicem:[2] et hujusmodi somnia. Neque vanitas ista tantum valet in dogmatibus, verum etiam in notionibus simplicibus.

XLVI.

Intellectus humanus, in iis quæ semel placuerunt (aut quia recepta sunt et credita, aut quia delectant), alia etiam omnia trahit ad suffragationem et consensum cum illis; et licet major sit instantiarum vis et copia quæ occurrunt in contrarium, tamen eas aut non observat aut contemnit aut distinguendo summovet et rejicit, non sine magno et pernicioso præjudicio, quo

surface of the sphere might represent inequalities in latitude. Compare (Nov. Org. II. 48.) what is said of the variations of which the "motus rotationis spontaneus" admits.

[1] The orb of the element of fire was supposed to lie above that of the element of air, and therefore might be said "non subjici sensui." The quaternion of elements follows directly from the quaternion of elementary qualities; namely, hot, cold, moist, dry. For these may be combined two and two in six different ways; two of these combinations are rejected as simply contradictory (viz. hot and cold, moist and dry); and to each of the other combinations corresponds one of the four elements. The diagram will illustrate.

[2] This doctrine of the decupla ratio of density of the elements was suggested by a passage in Aristotle [De Gen. et Cor. ii. 6.]. It is found in all books of mediæval physics. Cf. the *Margarita Philosophiæ*, ix. c. 4., or Alsted's *Encyclopædia*, where it is thus expressed: "Proportio elementorum ad se invicem ratione transmutationis est decupla, ratione magnitudinis non satis explorata." The transmutability of one element into another is an essential part of the Peripatetic doctrine of elements. It is found also in the *Timæus*.

prioribus illis syllepsibus authoritas maneat inviolata. Itaque recte respondit ille, qui, cum suspensa tabula in templo ei monstraretur eorum qui vota solverant quod naufragii periculo elapsi sint, atque interrogando premeretur anne tum quidem deorum numen agnosceret, quæsivit denuo, At *ubi sint illi depicti qui post vota nuncupata perierint?*[1] Eadem ratio est fere omnis superstitionis, ut in astrologicis, in somniis, omnibus, nemesibus, et hujusmodi; in quibus homines delectati hujusmodi vanitatibus advertunt eventus ubi implentur, ast ubi fallunt (licet multo frequentius) tamen negligunt et prætereunt. At longe subtilius serpit hoc malum in philosophiis et scientiis; in quibus quod semel placuit reliqua (licet multo firmiora et potiora) inficit et in ordinem redigit. Quinetiam licet abfuerit ea quam diximus delectatio et vanitas, is tamen humano intellectui error est proprius et perpetuus, ut magis moveatur et excitetur affirmativis quam negativis; cum rite et ordine æquum se utrique præbere debeat; quin contra, in omni axiomate vero constituendo, major est vis instantiæ negativæ.

XLVII.

Intellectus humanus illis quæ simul et subito mentem ferire et subire possunt maxime movetur; a quibus phantasia impleri et inflari consuevit; reliqua vero modo quodam, licet imperceptibili, ita se habere fingit et supponit, quomodo se habent pauca illa quibus mens obsidetur; ad illum vero transcursum ad instantias remotas et heterogeneas, per quas axiomata tanquam igne probantur, tardus omnino intellectus est et inhab-

[1] This story is told of Diagoras by Cicero, De Nat. Deor. III., and of Diogenes the Cynic by Diogenes Laertius.

ilis, nisi hoc illi per duras leges et violentum imperium imponatur.

XLVIII.

Gliscit intellectus humanus, neque consistere aut acquiescere potis est, sed ulterius petit; at frustra. Itaque incogitabile est ut sit aliquid extremum aut extimum mundi, sed semper quasi necessario occurrit ut sit aliquid ulterius:[1] neque rursus cogitari potest quomodo æternitas defluxerit ad hunc diem; cum distinctio illa quæ recipi consuevit, quod sit *infinitum a parte ante et a parte post*, nullo modo constare possit; quia inde sequeretur, quod sit unum infinitum alio infinito majus, atque ut consumatur infinitum, et vergat ad finitum. Similis est subtilitas de lineis semper divisibilibus,[2] ex impotentia cogitationis. At majore cum pernicie intervenit hæc impotentia mentis in inventione causarum: nam cum maxime universalia in natura positiva esse debeant, quemadmodum inveniuntur, neque sunt revera causabilia; tamen intellectus humanus, nescius acquiescere, adhuc appetit notiora. Tum vero ad ulteriora tendens ad proximiora recidit, videlicet ad causas finales, quæ sunt plane ex natura hominis potius quam universi;[3] atque ex hoc fonte philosophiam miris

[1] Thus Leibnitz derived from the principle of sufficient reason a proof of the infinite extent of the universe, alleging that if it were of finite dimensions no reason could be given for its occupying any one region of space rather than any other.

[2] In the phrase "subtilitas de lineis semper divisibilibus," reference is made to Aristotle, who in several places in his writings (particularly in the tract *περὶ ἀτόμων γραμμάτων*) maintains that in theory every magnitude is divisible sine limite.

[3] This censure appears to be expressed without sufficient limitation; for it is difficult to assent to the assertion that the notion of the final cause, considered generally, is more ex naturâ hominis than that of the efficient. The subject is one of which it is difficult to speak accurately; but it may be said that wherever we think that we recognise a tendency towards a

modis corruperunt. Est autem æque imperiti et leviter philosophantis, in maxime universalibus causam requirere, ac in subordinatis et subalternis causam non desiderare.[1]

XLIX.

Intellectus humanus luminis sicci non est;[2] sed recipit infusionem a voluntate et affectibus, id quod generat *Ad quod vult scientias.* Quod enim mavult homo verum esse, id potius credit. Rejicit itaque difficilia, ob inquirendi impatientiam; sobria, quia coarctant spem; altiora naturæ, propter superstitionem; lumen experientiæ, propter arrogantiam et fastum, ne videatur mens versari in vilibus et fluxis; paradoxa, propter opinionem vulgi; denique innumeris modis, iisque in-

fulfilment or realisation of an idea, there the notion of the final cause comes in. It can only be from inadvertence that Professor Owen has set the doctrine of the final cause as it were in antithesis to that of the unity of type: by the former he means the doctrine that the suitability of an animal to its mode of life is the one thing aimed at or intended in its structure. It cannot be doubted that Aristotle would have recognised the preservation of the type as not less truly a final cause than the preservation of the species or than the well-being of the individual. The final cause connects itself with what in the language of modern German philosophy is expressed by the phrase "the Idea in Nature."

[1] *ἔστι γὰρ ἀπαιδευσία τὸ μὴ γιγνώσκειν τίνων δεῖ ζητεῖν ἀπόδειξιν καὶ τίνων οὐ δεῖ, ὅλως μὲν γὰρ ἁπάντων ἀδύνατον ἀπόδειξιν εἶναι· εἰς ἄπειρον γὰρ ἂν βαδίζοι· ὥστε μήδ' οὕτως εἶναι ἀπόδειξιν.* — Metaph., iii. 4.

[2] Heraclitus apud Plut., De Esu Carnium. This doctrine of Idols is spoken of with great disrespect by Spinoza. He asserts that neither Des Cartes nor Bacon ever perceived the true source of error, and adds: "De Bacone parum dicam, qui de hâc re admodum confuse loquitur, et fere nihil probat, sed tantum narrat:" and concludes by saying, "quas adhuc alias causas adsignat (he has just enumerated three of the Idols of the Tribe) facile omnes ad unicam Cartesii reduci possunt; scilicet quia voluntas humana est libera et latior intellectu; sive, ut ipse Verulamius magis confuse loquitur, quia intellectus luminis sicci non est, sed recipit infusionem a voluntate." See *Spinoza to Oldenburg*, ep. 2. vol. ii. p. 146. of Bruder's edition.

terdum imperceptibilibus, affectus intellectum imbuit et inficit.

L.

At longe maximum impedimentum et aberratio intellectus humani provenit a stupore et incompetentia et fallaciis sensuum; ut ea quæ sensum feriant, illis quæ sensum immediate non feriunt, licet potioribus, præponderent. Itaque contemplatio fere desinit cum aspectu; adeo ut rerum invisibilium exigua aut nulla sit observatio. Itaque omnis operatio spirituum in corporibus tangibilibus inclusorum latet, et homines fugit. Omnis etiam subtilior meta-schematismus in partibus rerum crassiorum (quem vulgo alterationem vocant, cum sit revera latio per minima) latet similiter: et tamen nisi duo ista quæ diximus explorata fuerint et in lucem producta, nihil magni fieri potest in natura quoad opera. Rursus ipsa natura aëris communis et corporum omnium quæ aërem tenuitate superant (quæ plurima sunt) fere incognita est. Sensus enim per se res infirma est et aberrans; neque organa ad amplificandos sensus aut acuendos multum valent; sed omnis verior interpretatio naturæ conficitur per instantias, et experimenta idonea et apposita; ubi sensus de experimento tantum, experimentum de natura et re ipsa judicat.

LI.

Intellectus humanus fertur ad abstracta propter naturam propriam, atque ea quæ fluxa sunt fingit esse constantia. Melius autem est naturam secare, quam abstrahere;[1] id quod Democriti schola fecit, quæ magis penetravit in naturam quam reliquæ. Materia

[1] "Naturam secare," to dissect nature into her constituent parts; "Naturam abstrahere," to resolve nature into abstractions.

potius considerari debet, et ejus schematismi et metaschematismi, atque actus purus, et lex actus sive motus; Formæ enim commenta animi humani sunt, nisi libeat leges illas actus Formas appellare.

LII.

Hujusmodi itaque sunt Idola, quæ vocamus Idola Tribus; quæ ortum habent aut ex æqualitate substantiæ spiritus humani;[1] aut ex præoccupatione ejus; aut ab angustiis ejus; aut ab inquieto motu ejus; aut ab infusione affectuum; aut ab incompetentia sensuum; aut ab impressionis modo.

LIII.

Idola Specus ortum habent ex propria cujusque natura et animi et corporis; atque etiam ex educatione, et consuetudine, et fortuitis. Quod genus licet sit varium et multiplex, tamen ea proponemus in quibus maxima cautio est, quæque plurimum valent ad polluendum intellectum ne sit purus.

LIV.

Adamant homines scientias et comtemplationes particulares; aut quia authores et inventores se earum credunt; aut quia plurimum in illis operæ posuerunt, iisque maxime assueverunt. Hujusmodi vero homines, si ad philosophiam et contemplationes universales se contulerint, illas ex prioribus phantasiis detorquent et corrumpunt; id quod maxime conspicuum cernitur in Aristotele, qui naturalem suam

[1] Compare *Advanc. of Learning:* "That the spirit of man *being of an equal and uniform substance* doth usually suppose and feign in nature a greater equality and uniformity than is in truth." — *J. S.*

philosophiam logicæ suæ prorsus mancipavit, ut eam fere inutilem et contentiosam reddiderit. Chymicorum autem genus, ex paucis experimentis fornacis, philosophiam constituerunt phantasticam et ad pauca spectantem. Quinetiam Gilbertus, postquam in contemplationibus magnetis se laboriosissime exercuisset, confinxit statim philosophiam consentaneam rei apud ipsum præpollenti.

LV.

Maximum et velut radicale discrimen ingeniorum, quoad philosophiam et scientias, illud est; quod alia ingenia sint fortiora et aptiora ad notandas rerum differentias, alia ad notandas rerum similitudines. Ingenia enim constantia et acuta figere contemplationes et morari et hærere in omni subtilitate differentiarum possunt: ingenia autem sublimia et discursiva etiam tenuissimas et catholicas rerum similitudines et agnoscunt et componunt. Utrumque autem ingenium facile labitur in excessum, prensando aut gradus rerum aut umbras.

LVI.

Reperiuntur ingenia alia in admirationem antiquitatis, alia in amorem et amplexum novitatis effusa; pauca vero ejus temperamenti sunt ut modum tenere possint, quin aut quæ recte posita sunt ab antiquis convellant, aut ea contemnant quæ recte afferuntur a novis. Hoc vero magno scientiarum et philosophiæ detrimento fit; quum studia potius sint antiquitatis et novitatis, quam judicia; veritas autem non a felicitate temporis alicujus, quæ res varia est, sed a lumine naturæ et experientiæ, quod æternum est, petenda est. Itaque abneganda sunt ista studia, et videndum ne intellectus ab illis ad consensum abripiatur.

LVII.

Contemplationes naturæ et corporum in simplicitate sua, intellectum frangunt et comminuunt:[1] contemplationes vero naturæ et corporum in compositione et configuratione sua, intellectum stupefaciunt et solvunt.[2] Id optime cernitur in schola Leucippi et Democriti,[3] collata cum reliquis philosophiis. Illa enim ita versatur in particulis rerum, ut fabricas fere negligat: reliquæ autem ita fabricas intuentur attonitæ, ut ad simplicitatem naturæ non penetrent. Itaque alternandæ sunt contemplationes istæ et vicissim sumendæ; ut intellectus reddatur simul penetrans et capax, et eviteutur ea quæ diximus incommoda atque Idola ex iis provenientia.

LVIII.

Talis itaque esto prudentia contemplativa in arcendis et summovendis Idolis Specus; quæ aut ex prædominantia, aut ex excessu compositionis et divisionis, aut ex studiis erga tempora, aut ex objectis largis et minutis, maxime ortum habent. Generaliter autem pro suspecto habendum unicuique rerum naturam contemplanti, quicquid intellectum suum potissimum capit et detinet; tantoque major adhibenda in hujusmodi placitis est cautio, ut intellectus servetur æquus et purus.

LIX.

At Idola Fori omnium molestissima sunt; quæ ex fœdere verborum et nominum se insinuarunt in intel-

[1] *i. e.* Break up the understanding and distract it in minute observation of the parts. — *J. S.*

[2] *i. e.* Astonish and dissolve it in a vain endeavour to take in the whole. — *J. S.*

[3] That is, in the Atomists.

lectum. Credunt enim homines rationem suam verbis imperare; sed fit etiam ut verba vim suam super intellectum retorqueant et reflectant; quod philosophiam et scientias reddidit sophisticas et inactivas. Verba autem plerunque ex captu vulgi induntur, atque per lineas vulgari intellectui maxime conspicuas res secant. Quum autem intellectus acutior aut observatio diligentior eas lineas transferre velit, ut illæ sint magis secundum naturam, verba obstrepunt. Unde fit ut magnæ et solennes disputationes hominum doctorum sæpe in controversias circa verba et nomina desinant; a quibus (ex more et prudentia mathematicorum) incipere consultius foret, easque per definitiones in ordinem redigere. Quæ tamen definitiones, in naturalibus et materiatis, huic malo mederi non possunt; quoniam et ipsæ definitiones ex verbis constant, et verba gignunt verba: adeo ut necesse sit ad instantias particulares earumque series et ordines recurrere; ut mox dicemus, quum ad modum et rationem constituendi notiones et axiomata deventum fuerit.

LX.

Idola quæ per verba intellectui imponuntur duorum generum sunt. Aut enim sunt rerum nomina quæ non sunt (quemadmodum enim sunt res quæ nomine carent per inobservationem, ita sunt et nomina quæ carent rebus per suppositionem phantasticam); aut sunt nomina rerum quæ sunt, sed confusa et male terminata, et temere et inæqualiter a rebus abstracta. Prioris generis sunt Fortuna, Primum Mobile, Planetarum Orbes, Elementum Ignis, et hujusmodi commenta, quæ a vanis et falsis theoriis ortum habent.

Atque hoc genus Idolorum facilius ejicitur, quia per constantem abnegationem et antiquationem theoriarum exterminari possunt.

At alterum genus perplexum est et alte hærens; quod ex mala et imperita abstractione excitatur. Exempli gratia, accipiatur aliquod verbum (*Humidum*, si placet), et videamus quomodo sibi constent quæ per hoc verbum significantur; et invenietur verbum istud *Humidum* nihil aliud quam nota confusa diversarum actionum, quæ nullam constantiam aut reductionem patiuntur. Significat enim et quod circa aliud corpus facile se circumfundit; et quod in se est indeterminabile, nec consistere potest; et quod facile cedit undique; et quod facile se dividit et dispergit; et quod facile se unit et colligit; et quod facile fluit et in motu ponitur; et quod alteri corpori facile adhæret, idque madefacit; et quod facile reducitur in liquidum, sive colliquatur, cum antea consisteret. Itaque cum ad hujus nominis prædicationem et impositionem ventum sit, si alia accipias, flamma humida est; si alia accipias, aër humidus non est; si alia, pulvis minutus humidus est; si alia, vitrum humidum est; ut facile appareat istam notionem ex aqua tantum et communibus et vulgaribus liquoribus, absque ulla debita verificatione, temere abstractam esse.

In verbis autem gradus sunt quidam pravitatis et erroris. Minus vitiosum genus est nominum substantiæ alicujus, præsertim specierum infimarum et bene deductarum (nam notio Cretæ, Luti, bona; Terræ mala); vitiosius genus est actionum, ut Generare, Corrumpere, Alterare: vitiosissimum qualitatum (exceptis objectis sensus immediatis), ut Gravis, Levis, Tenuis, Densi, etc.; et tamen in omnibus istis fieri

non potest, quin sint aliæ notiones aliis paulo meliores, prout in sensum humanum incidit rerum copia.[1]

LXI.

At Idola Theatri innata non sunt, nec occulto insinuata in intellectum; sed ex fabulis theoriarum et perversis legibus demonstrationum plane indita et recepta. In his autem confutationes tentare et suscipere consentaneum prorsus non est illis quæ a nobis dicta sunt. Quum enim nec de principiis consentiamus nec de demonstrationibus, tollitur omnis argumentatio. Id vero bono fit fato, ut antiquis suus constet honos. Nihil enim illis detrahitur, quum de via omnino quæstio sit. Claudus enim (ut dicitur) in via antevertit cursorem extra viam. Etiam illud manifesto liquet, currenti extra viam, quo habilior sit et velocior, eo majorem contingere aberrationem.

Nostra vero inveniendi scientias ea est ratio, ut non multum ingeniorum acumini et robori relinquatur; sed quæ ingenia et intellectus fere exæquet. Quemadmodum enim ad hoc, ut linea recta fiat aut circulus perfectus describatur, multum est in constantia et exercitatione manus, si fiat ex vi manus propria; sin autem adhibeatur regula aut circinus, parum aut nihil; omnino similis est nostra ratio. Licet autem confutationum particularium nullus sit usus, de sectis tamen et generibus hujusmodi theoriarum nonnihil dicendum est; atque etiam paulo post de signis exterioribus, quod se male habeant; et postremo de causis tantæ

[1] Here, according to the tripartite distribution of the subject mentioned in aphorism 115, the first of the three Redargutiones ends. The following aphorisms from 61 to 115 contain the two others, Redargutio Philosophiarum and Redargutio Demonstrationum, which are not kept quite separate. The 69th and 70th aphorisms belong especially to the last. — *J. S.*

infelicitatis et tam diuturni et generalis in errore consensus; ut ad vera minus difficilis sit aditus, et intellectus humanus volentius expurgetur et Idola dimittat.

LXII.

Idola Theatri, sive theoriarum, multa sunt, et multo plura esse possunt, et aliquando fortasse erunt. Nisi enim per multa jam sæcula hominum ingenia circa religionem et theologiam occupata fuissent, atque etiam politiæ civiles (præsertim monarchiæ) ab istiusmodi novitatibus, etiam in contemplationibus, essent aversæ; ut cum periculo et detrimento fortunarum suarum in illas homines incumbant, non solum præmio destituti, sed etiam contemptui et invidiæ expositi; complures aliæ proculdubio philosophiarum et theoriarum sectæ, similes illis quæ magna varietate olim apud Græcos floruerunt, introductæ fuissent. Quemadmodum enim super phænomena ætheris plura themata cœli confingi possunt; similiter, et multo magis, super phænomena philosophiæ fundari possunt et constitui varia dogmata. Atque hujusmodi theatri fabulæ habent etiam illud quod in theatro poetarum usu venit, ut narrationes fictæ ad scenam narrationibus ex historia veris concinniores sint et elegantiores, et quales quis magis vellet.

In genere autem, in materiam philosophiæ sumitur aut multum ex paucis aut parum ex multis; ut utrinque philosophia super experientiæ et naturalis historiæ nimis angustam basin fundata sit, atque ex paucioribus quam par est pronunciet. Rationale enim genus philosophantium ex experientia arripiunt varia et vulgaria, eaque neque certo comperta nec diligenter examinata et pensitata; reliqua in meditatione atque ingenii agitatione ponunt.

Est et aliud genus philosophantium, qui in paucis experimentis sedulo et accurate elaborarunt, atque inde philosophias educere et confingere ausi sunt; reliqua miris modis ad ea detorquentes.

Est et tertium genus eorum, qui theologiam et traditiones ex fide et veneratione immiscent; inter quos vanitas nonnullorum ad petendas et derivandas scientias a Spiritibus scilicet et Geniis deflexit; ita ut stirps errorum, et philosophia falsa, genere triplex sit: Sophistica, Empirica, et Superstitiosa.

LXIII.

Primi generis exemplum in Aristotele maxime conspicuum est, qui philosophiam naturalem dialectica sua corrupit; quum mundum ex categoriis effecerit; animæ humanæ, nobilissimæ substantiæ, genus ex vocibus secundæ intentionis tribuerit;[1] negotium Densi et Rari, per quod corpora subeunt majores et minores dimensiones sive spatia, per frigidam distinctionem Actus et Potentiæ[2] transegerit; motum singulis corporibus unicum et proprium,[3] et si participent ex alio motu id aliunde moveri, asseruerit; et innumera alia, pro arbitrio suo, naturæ rerum imposuerit: magis ubique sollic-

[1] This censure refers to Aristotle's definition of the soul, *De Anima*, ii. 1.,—*ἡ πρώτη ἐντελέχεια σώματος φυσικοῦ ὀργανικοῦ*,—in which the word Entelecheia is, as the scholastic commentators remark, assigned as the genus to which the soul is referred.

[2] The "frigida distinctio actus et potentiæ" refers apparently to the *Phys. Ausc.* iv. c. 5.; where it is said that water is air in potentiâ, and vice versâ. The possibility of their reciprocal transmutation Bacon does not appear to have doubted of. [With reference to this censure of Aristotle, see the preface to the *Historia Densi et Rari*.—*J. S.*]

[3] "Simplicis corporis simplicem esse motum" is an important principle in Aristotelian physics, as one of the bases on which the system of the universe was made to depend. See, for instance, Melanchthon's *Initia Doctr. Physicæ*, p. 41.

itus quomodo quis respondendo se explicet, et aliquid reddatur in verbis positivum, quam de interna rerum veritate; quod etiam optime se ostendit in comparatione philosophiæ ejus ad alias philosophias quæ apud Græcos celebrabantur. Habent enim Homoiomera Anaxagoræ, Atomi Leucippi et Democriti, Cœlum et Terra Parmenidis, Lis et Amicitia Empedoclis, Resolutio corporum in adiaphoram naturam ignis et Replicatio eorundem ad densum Heracliti, aliquid ex philosopho naturali, et rerum naturam et experientiam et corpora sapiunt; ubi Aristotelis Physica nihil aliud quam dialecticæ voces plerunque sonet; quam etiam in Metaphysicis sub solenniore nomine, et ut magis scilicet realis, non nominalis, retractavit. Neque illud quenquam moveat, quod in libris ejus de animalibus, et in problematibus, et in aliis suis tractatibus, versatio frequens sit in experimentis. Ille enim prius decreverat, neque experientiam ad constituenda decreta et axiomata rite consuluit; sed postquam pro arbitrio suo decrevisset, experientiam ad sua placita tortam circumducit et captivam; ut hoc etiam nomine magis accusandus sit, quam sectatores ejus moderni (scholasticorum philosophorum genus) qui experientiam omnino deseruerunt.

LXIV.

At philosophiæ genus Empiricum placita magis deformia et monstrosa educit, quam Sophisticum aut rationale genus; quia non in luce notionum vulgarium (quæ licet tenuis sit et superficialis, tamen est quodammodo universalis et ad multa pertinens) sed in paucorum experimentorum angustiis et obscuritate fundatum est. Itaque talis philosophia iliis qui in hujusmodi experimentis quotidie versantur atque ex ipsis phantasiam

contaminarunt probabilis videtur, et quasi certa; cæteris, incredibilis et vana. Cujus exemplum notabile est in chymicis, eorumque dogmatibus; alibi autem vix hoc tempore invenitur, nisi forte in philosophia Gilberti. Sed tamen circa hujusmodi philosophias cautio nullo modo prætermittenda erat; quia mente jam prævidemus et auguramur, si quando homines, nostris monitis excitati, ad experientiam se serio contulerint (valere jussis doctrinis sophisticis), tum demum propter præmaturam et præproperam intellectus festinationem, et saltum sive volatum ad generalia et rerum principia, fore ut magnum ab hujusmodi philosophiis periculum immineat; cui malo etiam nunc obviam ire debemus.

LXV.

At corruptio philosophiæ ex Superstitione et theologia admista, latius omnino patet, et plurimum mali infert, aut in philosophias integras aut in earum partes. Humanus enim intellectus non minus impressionibus phantasiæ est obnoxius, quam impressionibus vulgarium notionum. Pugnax enim genus philosophiæ et Sophisticum illaqueat intellectum: at illud alterum phantasticum et tumidum, et quasi Poeticum, magis blanditur intellectui. Inest enim homini quædam intellectus ambitio, non minor quam voluntatis; præsertim in ingeniis altis et elevatis.

Hujus autem generis exemplum inter Græcos illuxescit, præcipue in Pythagora, sed cum superstitione magis crassa et onerosa conjunctum; at periculosius et subtilius in Platone, atque ejus schola. Invenitur etiam hoc genus mali in partibus philosophiarum reliquarum, introducendo formas abstractas, et causas finales, et causas primas; omittendo sæpissime medias, et hu-

jusmodi. Huic autem rei summa adhibenda est cautio. Pessima enim res est errorum Apotheosis, et pro peste intellectus habenda est, si vanis accedat veneratio. Huic autem vanitati nonnulli ex modernis summa levitate ita indulserunt, ut in primo capitulo Geneseos et in libro Job et aliis scripturis sacris, philosophiam naturalem fundare conati sint; *inter viva quærentes mortua.* Tantoque magis hæc vanitas inhibenda venit et coercenda, quia ex divinorum et humanorum malesana admistione non solum educitur philosophia phantastica, sed etiam religio hæretica. Itaque salutare admodum est, si mente sobria fidei tantum dentur quæ fidei sunt.[1]

LXVI.

Et de malis authoritatibus philosophiarum, quæ aut in vulgaribus notionibus, aut in paucis experimentis, aut in superstitione fundatæ sunt, jam dictum est. Dicendum porro est et de vitiosa materia contemplationum, præsertim in philosophia naturali. Inficitur autem intellectus humanus ex intuitu eorum quæ in artibus mechanicis fiunt, in quibus corpora per compositiones aut separationes ut plurimum alterantur; ut cogitet simile quiddam etiam in natura rerum universali fieri. Unde fluxit commentum illud Elementorum, atque illorum concursu, ad constituenda corpora naturalia. Rursus, quum homo naturæ libertatem[2] contempletur, incidit in species rerum, animalium, plantarum, mineralium; unde facile in eam labitur cogitationem, ut existimet esse in natura quasdam

[1] Compare Kepler's phrase: "Missum faciat Spiritum Sanctum, neque illum in scholas physicas cum ludibrio pertrahat." — *De Stellâ Martis Præfat.*

[2] That is, nature acting freely, in opposition to nature constrained by the conditions of our experiments.

formas rerum primarias, quas natura educere molitur, atque reliquam varietatem ex impedimentis et aberrationibus naturæ in opere suo conficiendo, aut ex diversarum specierum conflictu et transplantatione alterius in alteram, provenire. Atque prima cogitatio qualitates primas elementares, secunda proprietates occultas et virtutes specificas, nobis peperit;[1] quarum utraque pertinet ad inania contemplationum compendia, in quibus acquiescit animus et a solidioribus avertitur. At medici, in secundis rerum qualitatibus et operationibus, attrahendi, repellendi, attenuandi, inspissandi, dilatandi, astringendi, discutiendi, maturandi, et hujusmodi, operam præstant meliorem; atque nisi ex illis duobus (quæ dixi) compendiis (qualitatibus scilicet elementaribus, et virtutibus specificis) illa altera (quæ recte notata sunt) corrumperent, reducendo illa ad primas qualitates earumque mixturas subtiles et incommensurabiles, aut ea non producendo cum majore et diligentiore observatione ad qualitates tertias et quartas, sed contemplationem intempestive abrumpendo, illi multo melius profecissent. Neque hujusmodi virtutes (non dico eædem, sed similes) in humani corporis medicinis tantum exquirendæ sunt; sed etiam in cæterorum corporum naturalium mutationibus.

Sed multo adhuc majore cum malo fit, quod quiescentia rerum principia, *ex quibus*, et non moventia, *per quæ*, res fiunt, contemplentur et inquirant. Illa enim ad sermones, ista ad opera spectant. Neque enim vul-

[1] The elementary qualities are four in number, — hot, cold, dry, moist; and it is by combining them two and two that the Peripatetic conception of the nature of each element is formed. Thus fire is hot and dry, water cold and moist, &c. All the other qualities of bodies, which result from the combination and mutual modification of the elementary and primary qualities, were called secondary qualities.

gares illæ differentiæ Motus, quæ in naturali philosophia recepta notantur, Generationis, Corruptionis, Augmentationis, Diminutionis, Alterationis, et Lationis, ullius sunt pretii.[1] Quippe hoc sibi volunt; si corpus, alias non mutatum, loco tamen moveatur, hoc Lationem esse; si manente et loco et specie, qualitate mutetur, hoc Alterationem esse; si vero ex illa mutatione moles ipsa et quantitas corporis non eadem maneat, hoc Augmentationis et Diminutionis motum esse; si eatenus mutentur ut speciem ipsam et substantiam mutent et in alia migrent, hoc Generationem et Corruptionem esse. At ista mere popularia sunt, et nullo mode in naturam penetrant; suntque mensuræ et periodi tantum, non species motus. Inuunt enim illud *hucusque*, et non *quomodo* vel *ex quo fonte*. Neque enim de corporum appetitu, aut de partium eorum processu, aliquid significant; sed tantum quum motus ille rem aliter ac prius, crasso modo, sensui exhibeat, inde divisionem suam auspicantur. Etiam quum de causis motuum aliquid significare volunt, atque divisionem ex illis instituere, differentiam motus naturalis et violenti, maxima cum socordia, introducunt; quæ et ipsa omnino ex notione vulgari est; cum omnis motus violentus etiam naturalis revera sit, scilicet cum externum efficiens naturam alio modo in opere ponet quam quo prius.

At hisce omissis; si quis (exempli gratia) observaverit, inesse corporibus appetitum contactus ad invicem, ut non patiantur unitatem naturæ prorsus dirimi aut abscindi, ut vacuum detur; aut si quis dicat, inesse corporibus appetitum se recipiendi in naturalem suam

[1] In the *Physics*, Aristotle does not reckon Generation and Corruption as kinds of motion. Bacon's enumeration is that given in the *Categories*.

dimensionem vel tensuram, ut si ultra eam aut citra eam comprimantur aut distrahantur, statim in veterem sphæram et exporrectionem suam se recuperare et remittere moliantur; aut si quis dicat, inesse corporibus appetitum congregationis ad massas connaturalium suorum, densorum videlicet versus orbem terræ, tenuiorum et rariorum versus ambitum cœli; hæc et hujusmodi vere physica sunt genera motuum; at illa altera plane logica sunt et scholastica, ut ex hac collatione eorum manifesto liquet.

Neque minus etiam malum est, quod in philosophiis et contemplationibus suis, in principiis rerum atque ultimitatibus naturæ investigandis et tractandis opera insumatur; cum omnis utilitas et facultas operandi in mediis consistat. Hinc fit, ut abstrahere naturam homines non desinant, donec ad materiam potentialem et informem ventum fuerit; nec rursus secare naturam desinant, donec perventum fuerit ad atomum; quæ, etiamsi vera essent, tamen ad juvandas hominum fortunas parum possunt.[1]

LXVII.

Danda est etiam cautio intellectui de intemperantiis philosophiarum, quoad assensum præbendum aut cohibendum; quia hujusmodi intemperantiæ videntur Idola figere, et quodammodo perpetuare, ne detur aditus ad ea summovenda.

Duplex autem est excessus: alter eorum qui facile pronunciant, et scientias reddunt positivas et magistrales; alter eorum qui Acatalepsiam introduxerunt, et

[1] The construction of this sentence is somewhat abrupt. The relative *quæ* must be referred to some such antecedent as "doctrines of this character;" and for *possunt* we ought to read *possent*. For the antithesis between abstrahere and secare, see § 51. The first part of Bacon's censure refers to Aristotle.

inquisitionem vagam sine termino; quorum primus intellectum deprimit, alter enervat. Nam Aristotelis philosophia, postquam ceteras philosophias (more Ottomanorum erga fratres suos) pugnacibus confutationibus contrucidasset, de singulis pronunciavit; et ipse rursus quæstiones ex arbitrio suo subornat, deinde conficit; ut omnia certa sint et decreta; quod etiam apud successiones suas valet, et in usu est.

At Platonis schola Acatalepsiam introduxit, primo tanquam per jocum et ironiam, in odium veterum sophistarum, Protagoræ, Hippiæ, et reliquorum, qui nihil tam verebantur quam ne dubitare de re aliqua viderentur.[1] At Nova Academia Acatalepsiam dogmatizavit, et ex professo tenuit. Quæ licet honestior ratio sit quam pronunciandi licentia, quum ipsi pro se dicant se minime confundere inquisitionem, ut Pyrrho fecit et Ephectici, sed habere quod sequantur ut probabile, licet non habeant quod teneant ut verum; tamen postquam animus humanus de veritate invenienda semel desperaverit, omnino omnia fiunt languidiora: ex quo fit, ut deflectant homines potius ad amœnas disputationes et discursus, et rerum quasdam peragrationes, quam in severitate inquisitionis se sustineant. Verum quod a principio diximus, et perpetuo agimus, sensui et intellectui humano eorumque infirmitati authoritas non est deroganda, sed auxilia præbenda.

LXVIII.

Atque de Idolorum singulis generibus, eorumque apparatu jam diximus; quæ omnia constanti et solenni

[1] "Tum Velleius, fidenter sane, ut solent isti, nihil tam verens quam ne dubitare aliqua de re videretur; tanquam modo ex Deorum concilio et ex Epicuri intermundiis descendisset; Audite, inquit," &c. — *Cic. De Nat. Deor.* i. c. 8.

decreto sunt abneganda et renuncianda, et intellectus ab iis omnino liberandus est et expurgandus; ut non alius fere sit aditus ad regnum hominis, quod fundatur in scientiis, quam ad regnum cœlorum, *in quod, nisi sub persona infantis, intrare non datur.*

LXIX.

At pravæ demonstrationes, Idolorum veluti munitiones quædam sunt et præsidia; eæque quas in dialecticis habemus id fere agunt, ut mundum plane cogitationibus humanis, cogitationes autem verbis, addicant et mancipent. Demonstrationes vero potentia quadam philosophiæ ipsæ sunt et scientiæ. Quales enim eæ sunt, ac prout rite aut male institutæ, tales sequuntur philosophiæ et contemplationes. Fallunt autem et incompetentes sunt eæ quibus utimur in universo illo processu qui a sensu et rebus ducit ad axiomata et conclusiones. Qui quidem processus quadruplex est, et vitia ejus totidem. Primo, impressiones sensus ipsius vitiosæ sunt; sensus enim et destituit et fallit. At destitutionibus substitutiones, fallaciis rectificationes debentur. Secundo, notiones ab impressionibus sensuum male abstrahuntur, et interminatæ et confusæ sunt, quas terminatas et bene finitas esse oportuit. Tertio, inductio mala est, quæ per enumerationem simplicem principia concludit scientiarum, non adhibitis exclusionibus et solutionibus, sive separationibus naturæ debitis. Postremo, modus ille inveniendi et probandi, ut primo principia maxime generalia constituantur, deinde media axiomata ad ea applicentur et probentur, errorum mater est et scientiarum omnium calamitas. Verum de istis, quæ jam obiter perstringimus, fusius dicemus, cum veram interpretandæ naturæ

viam, absolutis istis expiationibus et expurgationibus mentis, proponemus.

LXX.

Sed demonstratio longe optima est experientia; modo hæreat in ipso experimento. Nam si traducatur ad alia quæ similia existimantur, nisi rite et ordine fiat illa traductio, res fallax est. At modus experiendi quo homines nunc utuntur cæcus est et stupidus. Itaque cum errant et vagantur nulla via certa, sed ex occursu rerum tantum consilium capiunt, circumferuntur ad multa sed parum promovent; et quandoque gestiunt quandoque distrahuntur; et semper inveniunt quod ulterius quærant. Fere autem ita fit, ut homines leviter et tanquam per ludum experiantur, variando paululum experimenta jam cognita; et si res non succedat, fastidiendo et conatum deserendo. Quod si magis serio et constanter ac laboriose ad experimenta se accingant, tamen in uno aliquo experimento eruendo operam collocant; quemadmodum Gilbertus in magnete, chymici in auro. Hoc autem faciunt homines instituto non minus imperito quam tenui. Nemo enim alicujus rei naturam in ipsa re fœliciter perscrutatur, sed amplianda est inquisitio ad magis communia.

Quod si etiam scientiam quandam et dogmata ex experimentis moliantur, tamen semper fere studio præpropero et intempestivo deflectunt ad praxin; non tantum propter usum et fructum ejusmodi praxeos, sed ut in opere aliquo novo veluti pignus sibi arripiant, se non inutiliter in reliquis versaturos; atque etiam aliis se venditent, ad existimationem meliorem comparandam de iis in quibus occupati sunt. Ita fit ut, more Atalantæ, de via decedant ad tollendum aureum pomum; interim vero cursum interrumpant, et victoriam emit-

tant e manibus. Verum in experientiæ vero curriculo, eoque ad nova opera producendo, Divina Sapientia omnino et ordo pro exemplari sumenda sunt. Deus autem primo die creationis lucem tantum creavit, eique operi diem integrum attribuit; nec aliquid materiati operis eo die creavit. Similiter et ex omnimoda experientia, primum inventio causarum et axiomatum verorum elicienda est; et lucifera experimenta, non fructifera quærenda. Axiomata autem recte inventa et constituta praxin non strictim sed confertim instruunt, et operum agmina ac turmas post se trahunt. Verum de experiendi viis, quæ non minus quam viæ judicandi obsessæ sunt et interclusæ, postea dicemus; impræsentiarum de experientia vulgari, tanquam de mala demonstratione, tantum loquuti. Jam vero postulat ordo rerum, ut de iis quorum paulo ante mentionem fecimus signis, quod philosophiæ et contemplationes in usu male se habeant, et de causis rei primo intuitu tam mirabilis et incredibilis, quædam subjungamus. Signorum enim notio præparat assensum: causarum vero explicatio tollit miraculum. Quæ duo ad extirpationem Idolorum ex intellectu faciliorem et clementiorem multum juvant.

LXXI.

Scientiæ quas habemus fere a Græcis fluxerunt. Quæ enim scriptores Romani aut Arabes aut recentiores addiderunt, non multa aut magni momenti sunt; et qualiacunque sint, fundata sunt super basin eorum quæ inventa sunt a Græcis.[1] Erat autem sapientia

[1] M. Chasles appears to have shown this with respect to the principle of position in arithmetic. We derive it, according to him, not from the Hindoos or Arabs, but from the Greeks. It is remarkable that the Chinese have from the earliest times known how to express any number by means of a few characters.

Græcorum professoria, et in disputationes effusa: quod genus inquisitioni veritatis adversissimum est. Itaque nomen illud Sophistarum, quod per contemptum ab iis qui se philosophos haberi voluerunt in antiquos rhetores rejectum et traductum est, Gorgiam, Protagoram, Hippiam, Polum, etiam universo generi competit Platoni, Aristoteli, Zenoni, Epicuro, Theophrasto, et eorum successoribus, Chrysippo, Carneadi, reliquis. Hoc tantum intererat; quod prius genus vagum fuerit et mercenarium, civitates circumcursando, et sapientiam suam ostentando, et mercedem exigendo; alterum vero solennius et generosius, quippe eorum qui sedes fixas habuerunt, et scholas aperuerunt, et gratis philosophati sunt. Sed tamen utrumque genus (licet cætera dispar) professorium erat, et ad disputationes rem deducebat, et sectas quasdam atque hæreses philosophiæ instituebat et propugnabat: ut essent fere doctrinæ eorum (quod non male cavillatus est Dionysius in Platonem) *Verba otiosorum senum ad imperitos juvenes.*[1] At antiquiores illi ex Græcis, Empedocles, Anaxagoras, Leucippus, Democritus, Parmenides, Heraclitus, Xenophanes, Philolaus, reliqui, (nam Pythagoram, ut superstitiosum, omittimus,) scholas (quod novimus) non aperuerunt; sed majore silentio, et severius, et simplicius, id est, minore cum affectatione et ostentatione, ad inquisitionem veritatis se contulerunt. Itaque et melius, ut arbitramur, se gesserunt; nisi quod opera eorum a levioribus istis, qui vulgari captui et affectui magis respondent ac placent, tractu temporis extincta sint: tempore (ut fluvio) leviora et magis inflata ad nos devehente, graviora et solida mergente. Neque tamen isti a nationis vitio prorsus immunes erant: sed

[1] *οἱ λόγοι σου γεροντιῶσι.* — Diog. Laert. in Platon. c. 18.

in ambitionem et vanitatem sectæ condendæ et auræ popularis captandæ nimium propendebant. Pro desperata autem habenda est veritatis inquisitio, cum ad hujusmodi inania deflectat. Etiam non omittendum videtur judicium illud, sive vaticinium potius, sacerdotis Ægyptii de Græcis: *quod semper pueri essent, neque haberent antiquitatem scientiæ, aut scientiam antiquitatis.*[1] Et certe habent id quod puerorum est; ut ad garriendum prompti sint, generare autem non possint: nam verbosa videtur sapientia eorum, et operum sterilis. Itaque ex ortu et gente philosophiæ quæ in usu est, quæ capiuntur signa bona non sunt.

LXXII.

Neque multo meliora sunt signa quæ ex natura temporis et ætatis capi possunt, quam quæ ex natura loci et nationis. Angusta enim erat et tenuis notitia per illam ætatem, vel temporis vel orbis: quod longe pessimum est, præsertim iis qui omnia in experientia ponunt. Neque enim mille annorum historiam, quæ digna erat nomine historiæ, habebant; sed fabulas et rumores antiquitatis. Regionum vero tractuumque mundi exiguam partem noverant; cum omnes hyperboreos, Scythas, omnes occidentales, Celtas, indistincte appellarent: nil in Africa ultra citimam Æthiopiæ partem, nil in Asia ultra Gangem, multo minus Novi Orbis provincias, ne per auditum sane aut famam aliquam certam et constantem, nossent; imo et plurima climata et zonæ, in quibus populi infiniti spirant et degunt, tanquam inhabitabiles ab illis pronuntiata sint: quinetiam peregrinationes Democriti, Platonis, Pythagoræ, non longinquæ prefecto sed potius suburbanæ, ut magnum

[1] Timæus, p. 22. b. *Ἕλληνες ἀεὶ παῖδές ἐστε, γέρων δὲ Ἕλλην οὐκ ἔστι.*

aliquid celebrarentur. Nostris autem temporibus et Novi Orbis partes complures et veteris orbis extrema undique innotescunt; et in infinitum experimentorum cumulus excrevit. Quare si ex nativitatis aut genituræ tempore (astrologorum more) signa capienda sint, nil magni de istis philosophiis significari videtur.

LXXIII.

Inter signa nullum magis certum aut nobile est, quam quod ex fructibus. Fructus enim, et opera inventa, pro veritate philosophiarum velut sponsores et fidejussores sunt. Atque ex philosophiis istis Græcorum, et derivationibus earum per particulares scientias, jam per tot annorum spatia vix unum experimentum adduci potest, quod ad hominum statum levandum et juvandum spectet, et philosophiæ speculationibus ac dogmatibus vere acceptum referri possit. Idque Celsus ingenue ac prudenter fatetur; nimirum experimenta medicinæ primo inventa fuisse, ac postea homines circa ea philosophatos esse et causas indagasse et assignasse; non ordine inverso evenisse, ut ex philosophia et causarum cognitione ipsa experimenta inventa aut deprompta essent.[1] Itaque mirum non erat, apud Ægyptios (qui rerum inventoribus divinitatem et consecrationem attribuerunt) plures fuisse brutorum animalium imagines quam hominum: quia bruta animalia, per instinctus naturales, multa inventa pepererunt; ubi homines ex

[1] "Repertis deinde medicinæ remediis homines de rationibus eorum disserere cœpisse: nec post rationem medicinam esse inventam, sed post inventam medicinam rationem esse quæsitam." — *Celsus, Præfatio.*

But this remark is not made by Celsus as the expression of his own opinion; on the contrary it occurs in his statement of the views entertained by the empirical school of medicine, to which he is decidedly opposed. The error of citing Celsus as an authority for it is repeated in several parts of Bacon's works. [See among others *De Augmentis*, v. 2. — *J. S.*]

sermonibus et conclusionibus rationalibus pauca aut nulla exhibuerint.

At chymicorum industria nonnulla peperit; sed tanquam fortuito et obiter, aut per experimentorum quandam variationem (ut mechanici solent,) non ex arte aut theoria aliqua; nam ea quam confinxerunt, experimenta magis perturbat quam juvat. Eorum etiam qui in magia (quam vocant) naturali versati sunt, pauca reperiuntur inventa; eaque levia et imposturæ propiora. Quocirca quemadmodum in religione cavetur, ut fides ex operibus monstretur; idem etiam ad philosophiam optime traducitur, ut ex fructibus judicetur et vana habeatur quæ sterilis sit; atque eo magis si, loco fructuum uvæ et olivæ, producat disputationum et contentionum carduos et spinas.

LXXIV.

Capienda etiam sunt signa ex incrementis et progressibus philosophiarum et scientiarum. Quæ enim in natura fundata sunt crescunt et augentur: quæ autem in opinione, variantur non augentur. Itaque si istæ doctrinæ plane instar plantæ a stirpibus suis revulsæ non essent, sed utero naturæ adhærerent atque ab eadem alerentur, id minime eventurum fuisset, quod per annos bis mille jam fieri videmus, nempe ut scientiæ suis hæreant vestigiis et in eodem fere statu maneant, neque augmentum aliquod memorabile sumpserint; quin potius in primo authore maxime floruerint, et deinceps declinaverint. In artibus autem mechanicis, quæ in natura et experientiæ luce fundatæ sunt, contra evenire videmus: quæ (quamdiu placent) veluti spiritu quodam repletæ continuo vegetant et crescunt; primo rudes, deinde commodæ, postea excultæ, et perpetuo auctæ.

LXXV.

Etiam aliud signum capiendum est (si modo signi appellatio huic competat; cum potius testimonium sit atque adeo testimoniorum omnium validissimum); hoc est propria confessio authorum, quos homines nunc sequuntur. Nam et illi qui tanta fiducia de rebus pronuntiant, tamen per intervalla cum ad se redeant, ad querimonias de naturæ subtilitate, rerum obscuritate, humani ingenii infirmitate, se convertunt. Hoc vero si simpliciter fieret, alios fortasse qui sunt timidiores ab ulteriori inquisitione deterrere, alios vero qui sunt ingenio alacriori et magis fidenti ad ulteriorem progressum acuere et incitare possit. Verum non satis illis est de se confiteri, sed quicquid sibi ipsis aut magistris suis incognitum aut intactum fuerit id extra terminos Possibilis ponunt, et, tanquam ex arte, cognitu aut factu impossibile pronuntiant: summa superbia et invidia, suorum inventorum infirmitatem in naturæ ipsius calumniam et aliorum omnium desperationem vertentes. Hinc schola Academiæ Novæ, quæ Acatalepsiam ex professo tenuit, et homines ad sempiternas tenebras damnavit. Hinc opinio, quod Formæ sive veræ rerum differentiæ (quæ revera sunt leges actus puri[1]) inventu impossibiles sint, et ultra hominem.[2] Hinc opiniones illæ in activa et operativa parte; calorem solis et ignis toto genere differre; ne

[1] Compare II. § 2. "Licet enim in naturâ nihil vere existat præter corpora individua *edentia actus puros ex lege*, &c. Eam autem legem ejusque paragraphos *Formarum* nomine intelligimus." And for an explanation of the meaning of "actus *purus*" see the General Preface, p. 75. — *J. S.*

[2] The doctrine of the incognoscibility of forms is quoted by Boyle and Sennert. See the "Quid sint qualitates occultæ" of the latter, from Scaliger's *Exercitationes in Cardanum*, — a work which seems to have been very generally read.

scilicet homines putent, se per opera ignis aliquid simile iis quæ in natura fiunt educere et formare posse. Hinc illud: compositionem tantum opus hominis, mistionem vero opus solius naturæ esse:[1] ne scilicet homines sperent aliquam ex arte corporum naturalium generationem aut transformationem. Itaque ex hoc signo homines sibi persuaderi facile patientur, ne cum dogmatibus non solum desperatis sed etiam desperationi devotis fortunas suas et labores misceant.

LXXVI.

Neque illud signum prætermittendum est; quod tanta fuerit inter philosophos olim dissensio et scholarum ipsarum varietas: quod satis ostendit viam a sensu ad intellectum non bene munitam fuisse, cum eadem materia philosophiæ (natura scilicet rerum) in tam vagos et multiplices errores abrepta fuerit et distracta. Atque licet hisce temporibus dissensiones et dogmatum diversitates circa principia ipsa et philosophias integras ut plurimum extinctæ sint; tamen circa partes philosophiæ innumeræ manent quæstiones et controversiæ; ut plane appareat, neque in philosophiis ipsis neque in modis demonstrationum aliquid certi aut sani esse.

LXXVII.

Quod vero putant homines in philosophia Aristotelis magnum utique consensum esse; cum post illam editam antiquorum philosophiæ cessaverint et exoleverint, ast apud tempora quæ sequuta sunt nil melius inventum fuerit; adeo ut illa tam bene posita et fundata

[1] The reference is to Galen, who in his treatise *De Natural. Facultatibus* contrasts the inwardly formative power of nature with the external operations of art. See note on *Temporis Partus Masculus.* — *J. S.*

videatur, ut utrumque tempus ad se traxerit: primo, quod de cessatione antiquarum philosophiarum post Aristotelis opera edita homines cogitant, id falsum est; diu enim postea, usque ad tempora Ciceronis et sæcula sequentia, manserunt opera veterum philosophorum. Sed temporibus insequentibus, ex inundatione barbarorum in imperium Romanum postquam doctrina humana velut naufragium perpessa esset, tum demum philosophiæ Aristotelis et Platonis, tanquam tabulæ ex materia leviore et minus solida, per fluctus temporum servatæ sunt. Illud etiam de consensu fallit homines, si acutius rem introspiciant. Verus enim consensus is est, qui ex libertate judicii (re prius explorata) in idem conveniente consistit. At numerus longe maximus eorum qui in Aristotelis philosophiam consenserunt, ex præjudicio et authoritate aliorum se illi mancipavit; ut sequacitas sit potius et coitio, quam consensus. Quod si fuisset ille verus consensus et late patens, tantum abest ut consensus pro vera et solida authoritate haberi debeat, ut etiam violentam præsumptionem inducat in contrarium. Pessimum enim omnium est augurium quod ex consensu capitur in rebus intellectualibus; exceptis divinis et politicis, in quibus suffragiorum jus est.[1] Nihil enim multis placet, nisi imaginationem feriat, aut intellectum vulgarium notionum nodis astringat, ut supra dictum est. Itaque optime traducitur illud Phocionis a moribus ad intellectualia; *ut statim se examinare debeant homines, quid erraverint aut pec-*

[1] Bacon does not mean that the votes of a majority are necessarily valid in matters of divinity or politics, but merely that, from the nature of the case, the argument ex consensu has more weight in these than in purely scientific questions.

caverint, si multitudo consentiat et complaudat.[1] Hoc signum igitur ex aversissimis est. Itaque quod signa veritatis et sanitatis philosophiarum et scientiarum quæ in usu sunt, male se habeant; sive capiantur ex originibus ipsarum, sive ex fructibus, sive ex progressibus, sive ex confessionibus authorum, sive ex consensu; jam dictum est.

LXXVIII.

Jam vero veniendum ad causas errorum, et tam diuturnæ in illis per tot sæcula moræ; quæ plurimæ sunt et potentissimæ: ut tollatur omnis admiratio, hæc quæ adducimus homines hucusque latuisse et fugisse; et maneat tantum admiratio, illa nunc tandem alicui mortalium in mentem venire potuisse, aut cogitationem cujuspiam subiisse: quod etiam (ut nos existimamus) felicitatis magis est cujusdam, quam excellentis alicujus facultatis; ut potius pro temporis partu haberi debeat, quam pro partu ingenii.

Primo autem tot sæculorum numerus, vere rem reputanti, ad magnas angustias recidit. Nam ex viginti quinque annorum centuriis, in quibus memoria et doctrina hominum fere versatur, vix sex centuriæ seponi et excerpi possunt, quæ scientiarum feraces earumve proventui utiles fuerunt. Sunt enim non minus temporum quam regionum eremi et vastitates. Tres enim tantum doctrinarum revolutiones et periodi recte numerari possunt: una, apud Græcos; altera, apud Romanos; ultima, apud nos, occidentales scilicet Europæ nationes: quibus singulis vix duæ centuriæ annorum merito attribui possunt. Media mundi tempora, quoad scientiarum segetem uberem aut lætam, infœlicia fuerunt. Neque enim causa est, ut vel

[1] Plutarch in Phocion, c. 8.

Arabum vel Scholasticorum mentio fiat: qui per intermedia tempora scientias potius contriverunt numerosis tractatibus, quam pondus earum auxerunt. Itaque prima causa tam pusilli in scientiis profectus ad angustias temporis erga illas propitii ritę et ordine refertur.

LXXIX.

At secundo loco se offert causa illa magni certe per omnia momenti: ea videlicet, quod per illas ipsas ætates quibus hominum ingenia et literæ maxime vel etiam mediocriter floruerint, Naturalis Philosophia minimam partem humanæ operæ sortia sit. Atque hæc ipsa nihilominus pro magna scientiarum matre haberi debet. Omnes enim artes et scientiæ ab hac stripe revulsæ, poliuntur fortasse et in usum effinguntur, sed nil admodum crescunt. At manifestum est, postquam Christiana fides recepta fuisset et adolevisset, longe maximam ingeniorum præstantissimorum partem ad Theologiam se contulisse; atque huic rei et amplissima præmia proposita, et omnis generis adjumenta copiosissime subministrata fuisse: atque hoc Theologiæ studium præcipue occupasse tertiam illam partem sive periodum temporis apud nos Europæos occidentales; eo magis, quod sub idem fere tempus et literæ florere et controversiæ circa religionem pullulare cœperint. At ævo superiori, durante periodo illa secunda apud Romanos, potissimæ philosophorum meditationes et industriæ in Morali Philosophia (quæ Ethnicis vice Theologiæ erat) occupatæ et consumptæ fuerunt: etiam summa ingenia illis temporibus ut plurimum ad res civiles se applicuerunt, propter magnitudinem imperii Romani, quod plurimorum hominum opera indigebat. At illa ætas, qua Naturalis Philosophia apud Græcos max-

ime florere visa est, particula fuit temporis minime diuturna; cum et antiquioribus temporibus septem illi qui sapientes nominabantur, omnes (præter Thaletem) ad Moralem Philosophiam et civilia se applicuerint; et posterioribus temporibus postquam Socrates philosophiam de cœlo in terras deduxisset, adhuc magis invaluerit Moralis Philosophia, et ingenia hominum a Naturali averterit.

At ipsissima illa periodus temporis in qua inquisitiones de natura viguerunt, contradictionibus et novorum placitorum ambitione corrupta est, et inutilis reddita. Itaque quandoquidem per tres istas periodos Naturalis Philosophia majorem in modum neglecta aut impedita fuerit, nil mirum si homines parum in ea re profecerint, cum omnino aliud egerint.

LXXX.

Accedit et illud, quod Naturalis Philosophia, in iis ipsis viris qui ei incubuerint, vacantem et integrum hominem, præsertim his recentioribus temporibus, vix nacta sit; nisi forte quis monachi alicujus in cellula, aut nobilis in villula lucubrantis, exemplum adduxerit: sed facta est demum Naturalis Philosophia instar transitus cujusdam et ponti-sternii ad alia.

Atque magna ista scientiarum mater mira indignitate ad officia ancillæ detrusa est; quæ medicinæ aut mathematicis operibus ministret, et rursus quæ adolescentium immatura ingenia lavet et imbuat velut tinctura quadam prima, ut aliam postea fœlicius et commodius excipiant. Interim nemo expectet magnum progressum in scientiis (præsertim in parte earum operativa), nisi Philosophia Naturalis ad scientias particulares producta fuerit, et scientiæ particulares rursus ad Naturalem

Philosophiam reductæ. Hinc enim fit, ut astronomia, optica, musica, plurimæ artes mechanicæ, atque ipsa medicina, atque (quod quis magis miretur) philosophia moralis et civilis, et scientiæ logicæ, nil fere habeant altitudinis in profundo; sed per superficiem et varietatem rerum tantum labantur: quia postquam particulares istæ scientiæ dispertitæ et constitutæ fuerint, a Philosophia Naturali non amplius alantur; quæ ex fontibus et veris contemplationibus motuum, radiorum, sonorum, texturæ et schematismi corporum, affectuum, et prehensionum intellectualium, novas vires et augmenta illis impertiri potuerit. Itaque minime mirum est si scientiæ non crescant, cum a radicibus suis sint separatæ.

LXXXI.

Rursus se ostendit alia causa potens et magna, cur scientiæ parum promoverint. Ea vero hæc est; quod fieri non possit, ut recte procedatur in curriculo, ubi ipsa meta non recte posita sit et defixa. Meta autem scientiarum vera et legitima non alia est, quam ut dotetur vita humana novis inventis et copiis. At turba longe maxima nihil ex hoc sapit, sed meritoria plane est et professoria; nisi forte quandoque eveniat, ut artifex aliquis acrioris ingenii et gloriæ cupidus novo alicui invento det operam; quod fere fit cum facultatum dispendio. At apud plerosque tantum abest ut homines id sibi proponant, ut scientiarum et artium massa augmentum obtineat, ut ex ea quæ præsto est massa nil amplius sumant aut quærant, quam quantum ad usum professorium aut lucrum aut existimationem aut hujusmodi compendia convertere possint. Quod si quis ex tanta multitudine scientiam affectu ingenuo et propter se expetat; invenietur tamen ille ipse, potius contempla-

tionum et doctrinarum varietatem, quam veritatis severam et rigidam inquisitionem sequi. Rursus, si alius quispiam fortasse veritatis inquisitor sit severior; tamen et ille ipse talem sibi proponet veritatis conditionem, quæ menti et intellectui satisfaciat in redditione causarum rerum quæ jampridem sunt cognitæ; non eam quæ nova operum pignora et novam axiomatum lucem assequatur. Itaque, si finis scientiarum a nemine adhuc bene positus sit, non mirum est si in iis quæ sunt subordinata ad finem, sequatur aberratio.

LXXXII.

Quemadmodum autem finis et meta scientiarum male posita sunt apud homines; ita rursus etiamsi illa recte posita fuissent, viam tamen sibi delegerunt omnino erroneam et imperviam. Quod stupore quodam animum rite rem reputanti perculserit; non ulli mortalium curæ aut cordi fuisse, ut intellectui humano, ab ipso sensu et experientia ordinata et bene condita, via aperiretur et muniretur; sed omnia vel traditionum caligini, vel argumentorum vertigini et turbini, vel casus et experientiæ vagæ et inconditæ undis et ambagibus permissa esse. Atque cogitet quis sobrie et diligenter, qualis sit ea via quam in inquisitione et inventione alicujus rei homines adhibere consueverunt; et primo notabit proculdubio inveniendi modum simplicem et inartificiosum, qui hominibus maxime est familiaris. Hic autem non alius est, quam ut is qui se ad inveniendum aliquid comparat et accingit, primo quæ ab aliis circa illa dicta sint inquirat et evolvat; deinde propriam meditationem addat, atque per mentis multam agitationem spiritum suum proprium sollicitet, et quasi invocet, ut sibi oracula pandat; quæ res omnino sine fundamento est, et in opinionibus tantum volvitur.

At alius quispiam dialecticam ad inveniendum advocet, quæ nomine tenus tantum ad id quod agitur pertinet. Inventio enim dialecticæ non est principiorum et axiomatum præcipuorum, ex quibus artes constant, sed eorum tantum quæ illis consentanea videntur. Dialectica enim magis curiosos et importunos, et sibi negotium facessentes, eamque interpellantes de probationibus et inventionibus principiorum sive axiomatum primorum, ad fidem, et veluti sacramentum cuilibet arti præstandum, notissimo responso rejicit.

Restat experientia mera, quæ, si occurrat, casus; si quæsita sit, experimentum nominatur. Hoc autem experientiæ genus nihil aliud est, quam (quod aiunt) scopæ dissolutæ,[1] et mera palpatio, quali homines noctu utuntur, omnia pertentando, si forte in rectam viam incidere detur; quibus multo satius et consultius foret diem præstolari, aut lumen accendere, et deinceps viam inire. At contra, verus experientiæ ordo primo lumen accendit, deinde per lumen iter demonstrat, incipiendo ab experientia ordinata et digesta, et minime præpostera aut erratica, atque ex ea educendo axiomata, atque ex axiomatibus constitutis rursus experimenta nova; quum nec verbum divinum in rerum massam absque ordine operatum sit.

Itaque desinant homines mirari si spatium scientiarum non confectum sit, cum a via omnino aberraverint; relicta prorsus et deserta experientia, aut in ipsa (tan

[1] *i. e.* a besom without a band. "Scopas dissolvere proverbio dicitur, rem aliquam prorsus inutilem reddere; nam scopæ solutæ nullæ sunt." — *Facciolati.* I do not remember any proverbial expression which answers to this in English; but the allusion is to the want of combination and coherency in these experiments. They are the "Experimenta omnigena absque ulla serie aut methodo tentata." (*De Augm.* v. 2.), and are opposed to the "Experientia Literata," or "Experientia certa lege procedens seriatim et continenter," spoken of in aphorisms 100 and 103. — *J. S.*

quam in labyrintho) se intricando et circumcursando; cum rite institutus ordo per experientiæ sylvas ad aperta axiomatum tramite constanti ducat.

LXXXIII.

Excrevit autem mirum in modum istud malum, ex opinione quadam sive æstimatione inveterata, verum tumida et damnosa; minui nempe mentis humanæ majestatem, si experimentis, et rebus particularibus sensui subjectis et in materia determinatis, diu ac multum versetur: præsertim quum hujusmodi res ad inquirendum laboriosæ, ad meditandum ignobiles, ad dicendum asperæ, ad practicam illiberales, numero infinitæ, et subtilitate tenues esse soleant. Itaque jam tandem huc res rediit, ut via vera non tantum deserta, sed etiam interclusa et obstructa sit; fastidita experientia, nedum relicta, aut male administrata.

LXXXIV.

Rursus vero homines a progressu in scientiis detinuit et fere incantavit reverentia antiquitatis, et virorum qui in philosophia magni habiti sunt authoritas, atque deinde consensus. Atque de consensu superius dictum est.

De antiquitate autem, opinio quam homines de ipsa fovent negligens omnino est, et vix verbo ipsi congrua. Mundi enim senium et grandævitas pro antiquitate vere habenda sunt; quæ temporibus nostris tribui debent, non juniori ætati mundi, qualis apud antiquos fuit. Illa enim ætas, respectu nostri antiqua et major,[1] respectu mundi ipsius nova et minor fuit. Atque revera quemadmodum majorem rerum humanarum noti-

[1] See note on De Augm. lib. i. near the middle.

tiam et maturius judicium ab homine sene exspectamus quam a juvene, propter experientiam et rerum quas vidit et audivit et cogitavit varietatem et copiam; eodem modo et a nostra ætate (si vires suas nosset, et experiri et intendere vellet) majora multo quam a priscis temporibus expectari par est; utpote ætate mundi grandiore, et infinitis experimentis et observationibus aucta et cumulata.

Neque pro nihilo æstimandum, quod per longinquas navigationes et peregrinationes (quæ sæculis nostris increbuerunt) plurima in natura patuerint et reperta sint, quæ novam philosophiæ lucem immittere possint. Quin et turpe hominibus foret, si globi materialis tractus, terrarum videlicet, marium, astrorum, nostris temporibus immensum aperti et illustrati sint; globi autem intellectualis fines inter veterum inventa et angustias cohibeantur.[1]

Authores vero quod attinet, summæ pusillanimitatis est authoribus infinita tribuere, authori autem authorum atque adeo omnis authoritatis, Tempori, jus suum denegare. Recte enim Veritas Temporis filia dicitur, non Authoritatis. Itaque mirum non est si fascina ista antiquitatis et authorum et consensus, hominum virtutem ita ligaverint, ut cum rebus ipsis consuescere (tanquam maleficiati) non potuerint.

[1] Compare Campanella: "Quapropter invidi sunt aut ingenio et fide in Deum exigui qui putant in Aristotele et aliis philosophis antiquis quiescendum, nec ultra quærendum: præsertim post evangelii lucem, et novi orbis ac stellarum inventionem, quâ prisci caruerunt, sicut et luce fidei quæ perficit in nobis naturam supra ethnicos non deprimit sub eorum jugo; cum eorum philosophia sit catechismus et nostra sit perfecta doctrina, teste Cyrillo: unde in mundo qui est liber Dei et sapientia [*q.* sapientiæ?] melius legere poterimus, si gratiam quæ est in nobis non negligamus." — *Apolog. pro Galileo.*

LXXXV.

Neque solum admiratio antiquitatis, authoritatis, et consensus, hominum industriam in iis quæ jam inventa sunt acquiescere compulit; verum etiam operum ipsorum admiratio, quorum copia jampridem facta est humano generi. Etenim quum quis rerum varietatem, et pulcherrimum apparatum qui per artes mechanicas ad cultum humanum congestus et introductus est, oculis subjecerit, eo certe inclinabit, ut potius ad opulentiæ humanæ admirationem quam ad inopiæ sensum accedat; minime advertens primitivas hominis observationes[1] atque naturæ operationes (quæ ad omnem illam varietatem instar animæ sunt, et primi motus) nec multas nec alte petitas esse; cætera ad patientiam hominum tantum, et subtilem et ordinatum manus vel instrumentorum motum, pertinere. Res enim (exempli gratia) subtilis est certe et accurata confectio horologiorum, talis scilicet, quæ cœlestia in rotis, pulsum animalium in motu successivo et ordinato, videatur imitari; quæ tamen res ex uno aut altero naturæ axiomate pendet.

Quod si quis rursus subtilitatem illam intueatur quæ ad artes liberales pertinet; aut etiam eam quæ ad corporum naturalium præparationem per artes mechanicas spectat, et hujusmodi res suspiciat; veluti inventionem motuum cœlestium in astronomia, concentuum in musica, literarum alphabeti (quæ etiam adhuc in regno Synarum in usu non sunt) in grammatica; aut rursus in mechanicis, factorum Bacchi et Cereris, hoc est, præ-

[1] "Primitivas hominis observationes" may be rendered "primary results of observation." The word *hominis* is merely used in antithesis to *naturæ* in the next clause.

parationum vini et cervisiæ, panificiorum, aut etiam mensæ delitiarum, et distillationum et similium; ille quoque si secum cogitet, et animum advertat, per quantos temporum circuitus (cum hæc omnia, præter distillationes,[1] antiqua fuerint) hæc ad eam quam nunc habemus culturam perducta sint, et (ut jam de horologiis dictum est) quam parum habeant ex observationibus et axiomatibus naturæ, atque quam facile, et tanquam per occasiones obvias et contemplationes incurrentes, ista inveniri potuerint; ille (inquam) ab omni admiratione se facile liberabit, et potius humanæ conditionis miserebitur, quod per tot sæcula tanta fuerit rerum et inventorum penuria et sterilitas. Atque hæc ipsa tamen quorum nunc mentionem fecimus inventa, philosophia et artibus intellectus antiquiora fuerunt. Adeo ut (si verum dicendum sit) cum hujusmodi scientiæ rationales et dogmaticæ inceperint, inventio operum utilium desierit.[2]

Quod si quis ab officinis ad bibliothecas se converterit, et immensam quam videmus librorum varietatem in admiratione habuerit, is examinatis et diligentius introspectis ipsorum librorum materiis et contentis, obstupescet certe in contrarium; et postquam nullum dari finem repetitionibus observaverit, quamque homines eadem agant et loquantur, ab admiratione varie-

[1] It has been said that Porson affirmed that distillation was known to the ancients. Dutens of course maintains that it was; but the passage he quotes from Dioscorides merely refers to sublimation. The word alembic is, as he remarks, a compound of the Arabic article with the Greek word ἄμβιξ, operculum; thus resembling in formation the word "almagest" and some others. But no valid conclusion can be drawn from hence. See Dutens, *Origine des Découvertes*, &c., p. 187. of the London edition. See a very interesting account of the history of distillation in Humboldt's *Examen critique de l' Histoire de la Géographie*, &c., vol. ii. p. 306.

[2] Thus we find Aristotle speaks of philosophy as having sprung up after all the wants of life were satisfied. See the beginning of the *Metaphysics*.

tatis transibit ad miraculum indigentiæ et paucitatis earum rerum quæ hominum mentes adhuc tenuerunt et occuparunt.

Quod si quis ad intuendum ea quæ magis curiosa habentur quam sana animum submiserit, et Alchymistarum aut Magorum opera penitius introspexerit, is dubitabit forsitan utrum risu an lachrymis potius illa digna sint. Alchymista enim spem alit æternam, atque ubi res non succedit errores proprios reos substituit; secum accusatorie reputando, se aut artis aut authorum vocabula non satis intellexisse, unde ad traditiones et auriculares susurros animum applicat; aut in practicæ suæ scrupulis et momentis aliquid titubatum esse,[1] unde experimenta in infinitum repetit; ac interim quum inter experimentorum sortes in quædam incidat aut ipsa facie nova aut utilitate non contemnenda, hujusmodi pignoribus animum pascit, eaque in majus ostentat et celebrat; reliqua spe sustentat. Neque tamen negandum est, Alchymistas non pauca invenisse et inventis utilibus homines donasse. Verum fabula illa non male in illos quadrat, de sene qui filiis aurum in vinea defossum (sed locum se nescire simulans) legaverit; unde illi vineæ fodiendæ diligenter incubuerunt, et aurum quidem nullum repertum, sed vindemia ex ea cultura facta est uberior.

At naturalis Magiæ cultores, qui per rerum Sympathias et Antipathias omnia expediunt, ex conjecturis otiosis et supinissimis, rebus virtutes et operationes admirabiles affinxerunt; atque si quando opera exhibuerint, ea illius sunt generis, ut ad admirationem et

[1] That is, that something has gone wrong in his manipulations, either in weighing his materials, or because the moment of projection has been missed.

novitatem, non ad fructum et utilitatem, accommodata sint.

In superstitiosa autem Magia (si et de hac dicendum sit) illud imprimis animadvertendum est, esse tantummodo certi cujusdam et definiti generis subjecta, in quibus artes curiosæ et superstitiosæ, per omnes nationes atque ætates atque etiam religiones, aliquid potuerint aut luserint. Itaque ista missa faciamus: interim nil mirum est si opinio copiæ causam inopiæ dederit.

LXXXVI.

Atque hominum admirationi quoad doctrinas et artes, per se satis simplici et prope puerili, incrementum accessit ab eorum astu et artificio qui scientias tractaverunt et tradiderunt. Illi enim ea ambitione et affectatione eas proponunt, atque in eum modum efformatas ac veluti personatas in hominum conspectum producunt, ac si illæ omni ex parte perfectæ essent et ad exitum perductæ. Si enim methodum aspicias et partitiones, illæ prorsus omnia complecti et concludere videntur quæ in illud subjectum cadere possunt. Atque licet membra illa male impleta et veluti capsulæ inanes sint, tamen apud intellectum vulgarem scientiæ formam et rationem integræ præ se ferunt.

At primi et antiquissimi veritatis inquisitores, meliore fide et fato, cognitionem illam, quam ex rerum contemplatione decerpere et in usum recondere statuebant, in *aphorismos*, sive breves easdemque sparsas nec methodo revinctas sententias, conjicere solebant; neque se artem universam complecti simulabant aut profitebantur. At eo quo nunc res agitur modo, minime mirum est si homines in iis ulteriora non quærant, quæ pro perfectis et numeris suis jampridem absolutis traduntur.

LXXXVII.

Etiam antiqua magnum existimationis et fidei incrementum acceperunt, ex eorum vanitate et levitate qui nova proposuerunt; præsertim in Philosophiæ Naturalis parte activa et operativa. Neque enim defuerunt homines vaniloqui et phantastici, qui partim ex credulitate, partim ex impostura, genus humanum promissis onerarunt: vitæ prolongationem, senectutis retardationem, dolorum levationem, naturalium defectuum reparationem, sensuum deceptiones, affectuum ligationes et incitationes, intellectualium facultatum illuminationes et exaltationes, substantiarum transmutationes, et motuum ad libitum roborationes et multiplicationes, aëris impressiones et alterationes, cœlestium influentiarum deductiones et procurationes, rerum futurarum divinationes, remotarum repræsentationes, occultarum revelationes, et alia complura pollicitando et ostentando. Verum de istis largitoribus non multum aberraverit qui istiusmodi judicium fecerit, tantum nimirum in doctrinis philosophiæ inter horum vanitates et veras artes interesse, quantum inter res gestas Julii Cæsaris aut Alexandri Magni et res gestas Amadicii ex Gallia aut Arthuri ex Britannia in historiæ narrationibus intersit. Inveniuntur enim clarissimi illi imperatores revera majora gessisse quam umbratiles isti heroes etiam fecisse fingantur; sed modis et viis scilicet actionum minime fabulosis et prodigiosis. Neque propterea æquum est veræ memoriæ fidem derogari, quod a fabulis illa quandoque læsa sit et violata. Sed interim minime mirum est si propositionibus novis (præsertim cum mentione operum) magnum sit factum præjudicium per istos impostores qui similia tentaverunt; cum vanitatis excessus et fas-

tidium etiam nunc omnem in ejusmodi conatibus magnanimitatem destruxerit.

LXXXVIII.

At longe majora a pusillanimitate, et pensorum quæ humana industria sibi proposuit parvitate et tenuitate, detrimenta in scientias invecta sunt. Et tamen (quod pessimum est) pusillanimitas ista non sine arrogantia et fastidio se offert.

Primum enim, omnium artium illa reperitur cautela jam facta familiaris, ut in qualibet arte authores artis suæ infirmitatem in naturæ calumniam vertant; et quod ars ipsorum non assequitur id ex eadem arte impossibile in natura pronunciant. Neque certe damnari potest ars, si ipsa judicet. Etiam philosophia quæ nunc in manibus est, in sinu suo posita quædam fovet, aut placita, quibus (si diligentius inquiratur) hoc hominibus omnino persuaderi volunt; nil ab arte vel hominis opere arduum, aut in naturam imperiosum et validum, expectari debere; ut de heterogenia caloris astri et ignis, et mistione, superius dictum est. Quæ si notentur accuratius, omnino pertinent ad humanæ potestatis circumscriptionem malitiosam, et ad quæsitam et artificiosam desperationem, quæ non solum spei auguria turbet, sed etiam omnes industriæ stimulos et nervos incidat atque ipsius experientiæ aleas abjiciat; dum de hoc tantum solliciti sint, ut ars eorum perfecta censeatur; gloriæ vanissimæ et perditissimæ dantes operam, scilicet ut quicquid adhuc inventum et comprehensum non sit, id omnino nec inveniri nec comprehendi posse in futurum credatur. At si quis rebus addere se[1] et novum

[1] Compare Redargutio Philosophiarum, — "Quare missis istis philosophiis abstractis, vos et ego, filii, *rebus ipsis nos adjungamus;*" and Præfatio,

aliquod reperire conetur, ille tamen omnino sibi proponet et destinabit unum aliquod inventum (nec ultra) perscrutari et eruere; ut magnetis naturam, maris fluxum et refluxum, thema cœli, et hujusmodi, quæ secreti aliquid habere videntur et hactenus parum fœliciter tractata sint: quum summæ sit imperitiæ, rei alicujus naturam in se ipsa perscrutari; quandoquidem eadem natura, quæ in aliis videtur latens et occulta, in aliis manifesta sit et quasi palpabilis, atque in illis admirationem, in his ne attentionem quidem moveat; ut fit in natura consistentiæ, quæ in ligno vel lapide non notatur, sed solidi appellatione transmittitur, neque amplius de fuga separationis aut solutionis continuitatis inquiritur: at in aquarum bullis eadem res videtur subtilis et ingeniosa; quæ bullæ se conjiciunt in pelliculas quasdam in hemisphærii formam curiose effictas, ut ad momentum temporis evitetur solutio continuitatis.

Atque prorsus illa ipsa quæ habentur pro secretis, in aliis habent naturam manifestam et communem; quæ nunquam se dabit conspiciendam, si hominum experimenta aut contemplationes in illis ipsis tantum versentur. Generaliter autem et vulgo, in operibus mechanicis habentur pro novis inventis, si quis jampridem inventa subtilius poliat, vel ornet elegantius, vel simul uniat et componat, vel cum usu commodius copulet, aut opus majore aut etiam minore quam fieri consuevit mole vel volumine exhibeat, et similia.

Itaque minime mirum est si nobilia et genere humano digna inventa in lucem extracta non sint, quum

p. 203. of this volume, — " Qui autem et ipsi experiri et *se scientiis addere*, earumque fines proferre, statuerunt, nec illi a receptis prorsus desciscere ausi sunt," &c. "*Addere se*" (says Heyne, Virg. Georg. i. 513.) " vulgari usu est adjungere se, accedere. . . . Inde si idem fit cum impetu, irruere, instare, *ἐπέχειν*." — *J. S.*

homines hujusmodi exiguis pensis et puerilibus contenti et delectati fuerint; quinetiam in iisdem se magnum aliquod sequutos aut assequutos putaverint.

LXXXIX.

Neque illud prætermittendum est, quod nacta sit Philosophia Naturalis per omnes ætates adversarium molestum et difficilem; superstitionem nimirum, et zelum religionis cæcum et immoderatum. Etenim videre est apud Græcos, eos qui primum causas naturales fulminis et tempestatum insuetis adhuc hominum auribus proposuerunt, impietatis in deos eo nomine damnatos: nec multo melius a nonnullis antiquorum patrum religionis christianæ exceptos fuisse eos, qui ex certissimis demonstrationibus (quibus nemo hodie sanus contradixerit) terram rotundam esse posuerunt, atque ex consequenti antipodas esse asseruerunt.

Quinetiam ut nunc sunt res, conditio sermonum de natura facta est durior et magis cum periculo, propter theologorum scholasticorum summas et methodos; qui cum theologiam (satis pro potestate) in ordinem redegerint et in artis formam effinxerint, hoc insuper effecerunt, ut pugnax et spinosa Aristotelis philosophia corpori religionis plus quam par erat immisceretur.[1]

Eodem etiam spectant (licet diverso modo) eorum commentationes, qui veritatem christianæ religionis ex

[1] Compare Kepler in the introduction to his great work *De Stellâ Martis:* — "In theologiâ quidem authoritatum, in Philosophiâ vero rationum esse momenta ponderanda. Sanctus igitur Lactantius qui terram negavit esse rotundam: Sanctus Augustinus qui rotunditate concessâ negavit tamen Antipodas: Sanctum Officium hodiernorum qui exilitate terræ concessâ negant tamen ejus motum: at magis mihi sancta Veritas qui terram et rotundam et Antipodibus circumhabitam et contemptissimæ parvitatis esse et denique per sidera ferri, salvo Doctorum ecclesiæ respectu, ex philosophiâ demonstro." See for a defence of St. Boniface, touching the story of the Antipodes and Virgilius Bishop of Saltzburg, Fromondus *De Orbe Terræ Immobili*, c. 4.

principiis et authoritatibus philosophorum deducere et confirmare haud veriti sunt; fidei et sensus conjugium tanquam legitimum multa pompa et solennitate celebrantes, et grata rerum varietate animos hominum permulcentes; sed interim divina humanis impari conditione permiscentes. At in hujusmodi misturis theologiæ cum philosophia, ea tantum quæ nunc in philosophia recepta sunt comprehenduntur; sed nova, licet in melius mutata, tantum non summoventur et exterminantur.

Denique invenias ex quorundam theologorum imperitia aditum alicui philosophiæ, quamvis emendatæ, pene interclusum esse. Alii siquidem simplicius subverentur ne forte altior in naturam inquisitio ultra concessum sobrietatis terminum penetret; traducentes et perperam torquentes ea quæ de divinis mysteriis in scripturis sacris adversus rimantes secreta divina dicuntur, ad occulta naturæ quæ nullo interdicto prohibentur. Alii callidius conjiciunt et animo versant, si media ignorentur, singula ad manum et virgulam divinam (quod religionis ut putant maxime intersit) facilius posse referri: quod nihil aliud est quam *Deo per mendacium gratificari velle.* Alii ab exemplo metuunt, ne motus et mutationes circa philosophiam in religionem incurrant ac desinant. Alii denique solliciti videntur, ne in naturæ inquisitione aliquid inveniri possit quod religionem (præsertim apud indoctos) subvertat, aut saltem labefactet. At isti duo posteriores metus nobis videntur omnino sapientiam animalem sapere; ac si homines, in mentis suæ recessibus et secretis cogitationibus, de firmitudine religionis et fidei in sensum imperio diffiderent ac dubitarent; et propterea ab inquisitione veritatis in natural-

ibus periculum illis impendere metuerent. At vere rem reputanti Philosophia Naturalis, post verbum Dei, certissima superstitionis medicina est; eademque probatissimum fidei alimentum. Itaque merito religioni donatur tanquam fidissima ancilla: cum altera voluntatem Dei, altera potestatem manifestet. Neque enim erravit ille qui dixit, *Erratis, nescientes scripturas et potestatem Dei:*[1] informationem de voluntate et meditationem de potestate nexu individuo commiscens et copulans. Interim minus mirum est si Naturalis Philosophiæ incrementa cohibita sint, cum religio, quæ plurimum apud animos hominum pollet, per quorundam imperitiam et zelum incautum in partem contrariam transierit et abrepta fuerit.

XC.

Rursus in moribus et institutis scholarum, academiarum, collegiorum, et similium conventuum, quæ doctorum hominum sedibus et eruditionis culturæ destinata sunt, omnia progressui scientiarum adversa inveniuntur. Lectiones enim et exercitia ita sunt disposita, ut aliud a consuetis haud facile cuiquam in mentem veniat cogitare aut contemplari. Si vero unus aut alter fortasse judicii libertate uti sustinuerit, is sibi soli hanc operam imponere possit; ab aliorum autem consortio nihil capiet utilitatis. Sin et hoc toleraverit, tamen in capessenda fortuna industriam hanc et magnanimitatem sibi non levi impedimento fore experietur. Studia enim hominum in ejusmodi locis in quorundam authorum scripta, veluti in carceres, conclusa sunt; a quibus si quis dissentiat, continuo ut homo turbidus et rerum novarum cupidus corripitur. At magnum

[1] Matt. xxii. 29.

certe discrimen inter res civiles et artes; non enim idem periculum a novo motu et a nova luce. Verum in rebus civilibus mutatio etiam in melius suspecta est ob perturbationem; cum civilia auctoritate, consensu, fama, et opinione, non demonstratione, nitantur. In artibus autem et scientiis, tanquam in metalli-fodinis, omnia novis operibus et ulterioribus progressibus circumstrepere debent. Atque secundum rectam rationem res ita se habet, sed interim non ita vivitur; sed ista, quam diximus, doctrinarum administratio et politia scientiarum augmenta durius premere consuevit.

XCI.

Atque insuper licet ista invidia cessaverit; tamen satis est ad cohibendum augmentum Scientiarum, quod hujusmodi conatus et industriæ præmiis careant. Non enim penes eosdem est cultura scientiarum et præmium. Scientiarum enim augmenta a magnis utique ingeniis proveniunt; at pretia et præmia scientiarum sunt penes vulgus aut principes viros, qui (nisi raro admodum) vix mediocriter docti sunt. Quinetiam hujusmodi progressus non solum præmiis et beneficentia hominum, verum etiam ipsa populari laude, destituti sunt. Sunt enim illi supra captum maximæ partis hominum, et ab opinionum vulgarium ventis facile obruuntur et extinguuntur. Itaque nil mirum si res illa non fœliciter successerit, quæ in honore non fuit.

XCII.

Sed longe maximum progressibus scientiarum et novis pensis ac provinciis in iisdem suscipiendis obstaculum deprehenditur in desperatione hominum, et suppositione Impossibilis. Solent enim viri prudentes et

severi in hujusmodi rebus plane diffidere: naturæ obscuritatem, vitæ brevitatem, sensuum fallacias, judicii infirmitatem, experimentorum difficultates, et similia secum reputantes. Itaque existimant esse quosdam scientiarum, per temporum et ætatum mundi revolutiones, fluxus et refluxus; cum aliis temporibus crescant et floreant, aliis declinent et jaceant: ita tamen, ut cum ad certum quendam gradum et statum pervenerint, nil ulterius possint.

Itaque si quis majora credat aut spondeat, id putant esse cujusdam impotentis et immaturi animi; atque hujusmodi conatus, initia scilicet læta, media ardua, extrema confusa habere. Atque cum hujusmodi cogitationes eæ sint quæ in viros graves et judicio præstantes facile cadant, curandum revera est ne rei optimæ et pulcherrimæ amore capti severitatem judicii relaxemus aut minuamus; et sedulo videndum quid spei affulgeat, et ex qua parte se ostendat; atque auris levioribus spei rejectis, eæ quæ plus firmitudinis habere videntur omnino discutiendæ sunt et pensitandæ. Quinetiam prudentia civilis ad consilium vocanda est et adhibenda, quæ ex præscripto diffidit, et de rebus humanis in deterius conjicit. Itaque jam et de spe dicendum est; præsertim cum nos promissores non simus, nec vim aut insidias hominum judiciis faciamus aut struamus, sed homines manu et sponte ducamus. Atque licet longe potentissimum futurum sit remedium ad spem imprimendam, quando homines ad particularia, præsertim in Tabulis nostris Inveniendi digesta et disposita (quæ partim ad secundam, sed multo magis ad quartam Instaurationis nostræ partem pertinent), adducemus; cum hoc ipsum sit non spes tantum, sed tanquam res ipsa: tamen ut omnia clementius fiant, pergendum est in

instituto nostro de præparandis hominum mentibus; cujus præparationis ista ostensio spei pars est non exigua. Nam absque ea, reliqua faciunt magis ad contristationem hominum (scilicet ut deteriorem et viliorem habeant de iis quæ jam in usu sunt opinionem quam nunc habent, et suæ conditionis infortunium plus sentiant et pernoscant), quam ad alacritatem aliquam inducendam, aut industriam experiendi acuendam. Itaque conjecturæ nostræ, quæ spem in hac re faciunt probabilem, aperiendæ sunt et præponendæ: sicut Columbus fecit, ante navigationem illam suam mirabilem maris Atlantici, cum rationes adduxerit cur ipse novas terras et continentes, præter eas quæ ante cognitæ fuerunt, inveniri posse confideret: quæ rationes, licet primo rejectæ, postea tamen experimento probatæ sunt et rerum maximarum causæ et initia fuerunt.

XCIII.

Principium autum sumendum a Deo:[1] hoc nimirum quod agitur, propter excellentem in ipso boni naturam, manifeste a Deo esse, qui author boni et pater luminum est. In operationibus autem divinis, initia quæque tenuissima exitum certo trahunt. Atque quod de spiritualibus dictum est, *regnum Dei non venit cum observatione*, id etiam in omni majore opere providentiæ divinæ evenire reperitur; ut omnia sine strepitu et sonitu placide labantur, atque res plane agatur priusquam homines eam agi putent aut advertant. Neque omittenda est prophetia Danielis de ultimis mundi temporibus: *Multi pertransibunt et multiplex erit scientia:* manifeste innuens et significans esse in fatis, id est in providentia, ut pertransitus mundi (qui

[1] Ἐκ Διὸς ἀρχώμεσθα. — Aratus, Phænom. l. 1.

per tot longinquas navigationes impletus plane aut jam in opere esse videtur) et augmenta scientiarum in eandem ætatem incidant.

XCIV.

Sequitur ratio omnium maxima ad faciendam spem; nempe ex erroribus temporis præteriti et viarum adhuc tentatarum. Optima enim est ea reprehensio, quam de statu civili haud prudenter administrato quispiam his verbis complexus est: *Quod ad præterita pessimum est, id ad futura optimum videri debet. Si enim vos omnia quæ ad officium vestrum spectant præstitissetis, neque tamen res vestræ in meliore loco essent, ne spes quidem ulla reliqua foret eas in melius provehi posse. Sed cum rerum vestrarum status non a vi ipsa rerum sed ab erroribus vestris male se habeat, sperandum est, illis erroribus missis aut correctis, magnam rerum in melius mutationem fieri posse.*[1] Simili modo, si homines per tanta annorum spatia viam inveniendi et colendi scientias tenuissent, nec tamen ulterius progredi potuissent, audax proculdubio et temeraria foret opinio, posse rem in ulterius provehi. Quod si in via ipsa erratum sit, atque hominum opera in iis consumpta in quibus minime oportebat, sequitur ex eo, non in rebus ipsis difficultatem oriri, quæ potestatis nostræ non sunt, sed in intellectu humano ejusque usu et applicatione, quæ res remedium et medicinam suscipit. Itaque optimum fuerit illos ipsos errores proponere: quot enim fuerint errorum impedimenta in præterito, tot sunt spei argumenta in futurum. Ea vero licet in his quæ superius dicta sunt non intacta omnino

[1] Demosthenes: see the first Philippic, p. 40.; and the third, p. 112. Ed. Reisk.

fuerint, tamen ea etiam nunc breviter verbis nudis ac simplicibus repræsentare visum est.

XCV.

Qui tractaverunt scientias aut Empirici aut Dogmatici fuerunt. Empirici, formicæ more, congerunt tantum et utuntur; Rationales, aranearum more, telas ex se conficiunt:[1] apis vero ratio media est, quæ materiam ex floribus horti et agri elicit, sed tamen eam propria facultate vertit et digerit. Neque absimile philosophiæ verum opificium est; quod nec mentis viribus tantum aut præcipue nititur, neque ex historia naturali et mechanicis experimentis præbitam materiam, in memoria integram, sed in intellectu mutatam et subactam, reponit. Itaque ex harum facultatum (experimentalis scilicet et rationalis) arctiore et sanctiore fœdere (quod adhuc factum non est) bene sperandum est.

XCVI.

Naturalis Philosophia adhuc sincera non invenitur, sed infecta et corrupta: in Aristotelis schola per logicam, in Platonis schola per theologiam naturalem; in secunda schola Platonis, Procli et aliorum, per mathematicam; quæ philosophiam naturalem terminare, non generare aut procreare debet. At ex philosophia naturali pura et impermista meliora speranda sunt.

XCVII.

Nemo adhuc tanta mentis constantia et rigore inventus est, ut decreverit et sibi imposuerit, theorias

[1] Ἀρίστων τοὺς λόγους τῶν διαλεκτικῶν τοῖς τῶν ἀραχνίων ὑφάσμασιν εἰκαζεν, οὐδὲν μὲν χρησίμους, λίαν δὲ τεχνικούς (perhaps χρησίμοις and τεχνικοῖς). — Stobæus, Floril. § 82. Compare *De Augmentis*, v. 2.

et notiones communes penitus abolere, et intellectum abrasum et æquum ad particularia de integro applicare. Itaque ratio illa humana quam habemus, ex multa fide et multo etiam casu, nec non ex puerilibus quas primo hausimus notionibus, farrago quædam est et congeries.

Quod si quis ætate matura et sensibus integris et mente repurgata se ad experientiam et ad particularia de integro applicet, de eo melius sperandum est. Atque hac in parte nobis spondemus fortunam Alexandri Magni: neque quis nos vanitatis arguat, antequam exitum rei audiat, quæ ad exuendam omnem vanitatem spectat.

Etenim de Alexandro et ejus rebus gestis Æschines ita loquutus est: *Nos certe vitam mortalem non vivimus; sed in hoc nati sumus, ut posteritas de nobis portenta narret et prædicet:* perinde ac si Alexandri res gestas pro miraculo habuisset.[1]

At ævis sequentibus Titus Livius melius rem advertit et introspexit, atque de Alexandro hujusmodi quippiam dixit: *Eum non aliud quam bene ausum vana contemnere.*[2] Atque simile etiam de nobis judicium futuris temporibus factum iri existimamus: *nos nil magni fecisse, sed tantum ea quæ pro magnis habentur minoris fecisse.* Sed interim (quod jam diximus) non est spes nisi in *regeneratione* scientiarum; ut eæ scilicet ab Experientia certo ordine excitentur et rursus condantur: quod adhuc factum esse aut cogitatum nemo (ut arbitramur) affirmaverit.

XCVIII.

Atque Experientiæ fundamenta (quando ad hanc

[1] Æschines, De Coronâ, p. 72. Ed. H. Stephan.
[2] Lib. ix. c. 17.

omnino deveniendum est) aut nulla aut admodum infirma adhuc fuerunt; nec particularium sylva et materies, vel numero vel genere vel certitudine, informando intellectui competens aut ullo modo sufficiens, adhuc quæsita est et congesta. Sed contra homines docti (supini sane et faciles) rumores quosdam Experientiæ, et quasi famas et auras ejus, ad philosophiam suam vel constituendam vel confirmandam exceperunt, atque illis nihilominus pondus legitimi testimonii attribuerunt. Ac veluti si regnum aliquod aut status non ex literis et relationibus a legatis et nuntiis fide-dignis missis, sed ex urbanorum sermunculis et ex triviis, consilia sua et negotia gubernaret; omnino talis in philosophiam administratio, quatenus ad Experientiam, introducta est. Nil debitis modis exquisitum, nil verificatum, nil numeratum, nil appensum, nil dimensum in Naturali Historia reperitur. At quod in observatione indefinitum et vagum, id in informatione fallax et infidum est. Quod si cui hæc mira dictu videantur et querelæ minus justæ propiora, cum Aristoteles, tantus ipse vir et tanti regis opibus subnixus, tam accuratam de Animalibus historiam confecerit, atque alii nonnulli majore diligentia (licet strepitu minore) multa adjecerint, et rursus alii de plantis, de metallis, et fossilibus, historias et narrationes copiosas conscripserint; is sane non satis attendere et perspicere videtur quid agatur in præsentia. Alia enim est ratio Naturalis Historiæ quæ propter se confecta est; alia ejus quæ collecta est ad informandum intellectum in ordine ad condendam philosophiam. Atque hæ duæ historiæ tum aliis rebus, tum præcipue in hoc differunt; quod prima ex illis specierum naturalium varietatem, non artium mechanicarum experimenta, contineat. Quemadmodum enim in civilibus

ingenium cujusque et occultus animi affectuumque sensus melius elicitur cum quis in perturbatione ponitur, quam alias: simili modo, et occulta naturæ magis se produnt per vexationes artium, quam cum cursu suo meant. Itaque tum demum bene sperandum est de Naturali Philosophia, postquam Historia Naturalis (quæ ejus basis est et fundamentum) melius instructa fuerit; antea vero minime.

XCIX.

Atque rursus in ipsa experimentorum mechanicorum copia, summa eorum quæ ad intellectus informationem maxime faciunt et juvant detegitur inopia. Mechanicus enim, de veritatis inquisitione nullo modo sollicitus, non ad alia quam quæ operi suo subserviunt aut animum erigit aut manum porrigit. Tum vero de scientiarum ulteriore progressu spes bene fundabitur, quum in Historiam Naturalem recipientur et aggregabuntur complura experimenta, quæ in se nullius sunt usus, sed ad inventionem causarum et axiomatum tantum faciunt; quæ nos *lucifera* experimenta, ad differentiam *fructiferorum*, appellare consuevimus. Illa autem miram habent in se virtutem et conditionem; hanc videlicet, quod nunquam fallant aut frustrentur. Cum enim ad hoc adhibeantur, non ut opus aliquod efficiant sed ut causam naturalem in aliquo revelent, quaquaversum cadunt, intentioni æque satisfaciunt; cum quæstionem terminent.

C.

At non solum copia major experimentorum quærenda est et procuranda, atque etiam alterius generis, quam adhuc factum est; sed etiam methodus plane alia et ordo et processus continuandæ et provehendæ Experi-

entiæ introducenda. Vaga enim Experientia et se tantum sequens (ut superius dictum est) mera palpatio est, et homines potius stupefacit quam informat. At cum Experientia lege certa procedet, seriatim et continenter, de scientiis aliquid melius sperari poterit.

CI.

Postquam vero copia et materies Historiæ Naturalis et Experientiæ, talis qualis ad opus intellectus sive ad opus philosophicum requiritur, præsto jam sit et parata; tamen nullo modo sufficit intellectus, ut in illam materiem agat sponte et memoriter; non magis, quam si quis computationem alicujus ephemeridis memoriter se tenere et superare posse speret. Atque hactenus tamen potiores meditationis partes quam scriptionis in inveniendo fuerunt; neque adhuc Experientia literata[1] facta est: atqui nulla nisi de scripto inventio probanda est. Illa vero in usum inveniente, ab Experientia facta demum literata melius sperandum.

CII.

Atque insuper cum tantus sit particularium numerus et quasi exercitus, isque ita sparsus et diffusus, ut intellectum disgreget et confundat, de velitationibus et levibus motibus et transcursibus intellectus non bene sperandum est; nisi fiat instructio et coordinatio, per tabulas

[1] "Experientia literata" does not appear to be used here in the same sense as in Aph. 103., or in the *De Augmentis*, v. 2.: "Cum quis experimenta omnigena absque ullâ serie aut methodo tentet, ea demum mera est palpatio: cum vero nonnullâ utatur in experimentando directione et ordine, perinde est ac si manu ducatur. Atque hoc ipsum est quod per Experientiam Literatam intelligimus." Here it is used merely for a mode of experimenting in which the results are recorded in writing. The "experientia literata" of the *De Augmentis* answers to the "experientia certâ lege procedens" of the last aphorism. — *J. S.*

inveniendi idoneas et bene dispositas et tanquam vivas, eorum quæ pertinent ad subjectum in quo versatur inquisitio, atque ad harum tabularum auxilia præparata et digesta mens applicetur.

CIII.

Verum post copiam particularium rite et ordine veluti sub oculos positorum, non statim transeundum est ad inquisitionem et inventionem novorum particularium aut operum ; aut saltem, si hoc fiat, in eo non acquiescendum. Neque enim negamus, postquam omnia omnium artium experimenta collecta et digesta fuerint atque ad unius hominis notitiam et judicium pervenerint, quin ex ipsa traductione experimentorum unius artis in alias multa nova inveniri possint ad humanam vitam et statum utilia, per istam Experientiam quam vocamus Literatam ;[1] sed tamen minora de ea speranda sunt ; majora vero a nova luce Axiomatum ex particularibus illis certa via et regula eductorum, quæ rursus nova particularia indicent et designent. Neque enim in plano via sita est, sed ascendendo et descendendo ; ascendendo primo ad Axiomata, descendendo ad Opera.

CIV.

Neque tamen permittendum est, ut intellectus a particularibus ad axiomata remota et quasi generalissima (qualia sunt principia, quæ vocant, artium et rerum) saliat et volet ; et ad eorum immotam veritatem axiomata media probet et expediat : quod adhuc factum est, prono ad hoc impetu naturali intellectus, atque etiam ad hoc ipsum, per demonstrationes quæ fiunt per syllo-

[1] Here "experientia literata" is the same as in the *De Augmentis*. See the last note. — *J. S.*

gismum, jampridem edocto et assuefacto. Sed de scientiis tum demum bene sperandum est, quando per scalam veram, et per gradus continuos et non intermissos aut hiulcos, a particularibus ascendetur ad axiomata minora, et deinde ad media, alia aliis superiora, et postremo demum ad generalissima. Etenim axiomata infima non multum ab experientia nuda discrepant. Suprema vero illa et generalissima (quæ habentur) notionalia sunt et abstracta, et nil habent solidi. At media sunt axiomata illa vera et solida et viva, in quibus humanæ res et fortunæ sitæ sunt; et supra hæc quoque, tandem ipsa illa generalissima; talia scilicet quæ non abstracta sint, sed per hæc media vere limitantur.[1]

Itaque hominum intellectui non plumæ addendæ, sed plumbum potius et pondera; ut cohibeant omnem saltum et volatum. Atque hoc adhuc factum non est; quum vero factum fuerit, melius de scientiis sperare licebit.

CV.

In constituendo autem axiomate, forma Inductionis alia quam adhuc in usu fuit excogitanda est; eaque non ad principia tantum (quæ vocant) probanda et invenienda, sed etiam ad axiomata minora et media, denique omnia. Inductio enim quæ procedit per enumerationem simplicem res puerilis est, et precario concludit, et periculo exponitur ab instantia contradictoria, et plerumque secundum pauciora quam par est, et ex his tantummodo quæ præsto sunt, pronunciat. At Inductio quæ ad inventionem et demonstrationem scientiarum et artium erit utilis naturam separare debet, per

[1] That is, of which these intermediate axioms are really limitations, *i. e.* particular cases.

rejectiones et exclusiones debitas; ac deinde, post negativas tot quot sufficiunt, super affirmativas concludere; quod adhuc factum non est, nec tentatum certe, nisi tantummodo a Platone, qui ad excutiendas definitiones et ideas, hac certe forma inductionis aliquatenus utitur.[1] Verum ad hujus inductionis, sive demonstrationis, instructionem bonam et legitimam, quamplurima adhibenda sunt quæ adhuc nullius mortalium cogitationem subiere; adeo ut in ea major sit consumenda opera, quam adhuc consumpta est in syllogismo. Atque hujus inductionis auxilio, non solum ad axiomata invenienda, verum etiam ad notiones terminandas, utendum est.[2] Atque in hac certe Inductione spes maxima sita est.

CVI.

At in axiomatibus constituendis per hanc inductionem, examinatio et probatio etiam facienda est, utrum quod constituitur axioma aptatum sit tantum et ad mensuram factum eorum particularium ex quibus extrahitur; an vero sit amplius et latius. Quod si sit amplius aut latius, videndum an eam suam amplitudinem et latitudinem per novorum particularium designationem, quasi fide-jussione quadam, firmet;[3] ne

[1] This is one of many passages which show that Bacon was very far from asserting that he was the first to propose an inductive method. It is remarkable that M. de St. Hilaire in his translation of the treatise *De Animâ* of Aristotle has repeated the popular assertion that Bacon claimed to be the first discoverer of induction.

[2] "Ad notiones terminandas" may be rendered "in order to the formation of conceptions." This passage, especially when compared with the 14th Aphorism, shows that Bacon contemplated a twofold application of induction, though he has left nothing on the subject of the formation of conceptions.

[3] The meaning of this will be made clearer by comparing it with the following passage in *Valerius Terminus*:—

"That the discovery of new works or active directions not known before

vel in jam notis tantum hæreamus, vel laxiore fortasse complexu umbras et formas abstractas, non solida et determinata in materia, prensemus. Hæc vero cum in usum venerint, solida tum demum spes merito affulserit.

CVII.

Atque hic etiam resumendum est, quod superius dictum est de Naturali Philosophia producta, et scientiis particularibus ad eam reductis, ut non fiat scissio et truncatio scientiarum ; nam etiam absque hoc minus de progressu sperandum est.

CVIII.

Atque de desperatione tollenda et spe facienda, ex præteriti temporis erroribus valere jussis aut rectificatis, jam dictum est. Videndum autem et si quæ alia sint quæ spem faciant. Illud vero occurrit; si hominibus non quærentibus, et aliud agentibus, multa utilia, tanquam casu quodam aut per occasionem, inventa sint ; nemini dubium esse posse, quin iisdem quærentibus et hoc agentibus, idque via et ordine, non impetu et desultorie, longe plura detegi necesse sit. Licet enim semel aut iterum accidere possit, ut quispiam in id forte fortuna incidat, quod magno conatu et de industria scrutantem antea fugit; tamen in sum-

is the only trial to be accepted of; and yet not that neither in case where one particular giveth light to another, but where particulars induce an axiom or observation, which axiom found out discovereth and designeth new particulars. That the nature of this trial is not only on the point whether the knowledge be profitable or no, but even upon the point whether the knowledge be true or no. Not because you may always conclude that the axiom which discovereth new instances is true; but contrariwise you may safely conclude that, if you discover not any new instance, it is vain and untrue. That by new instances are not always to be understood uew recipes, but new assignations; and of the diversity between these two." — *Val. Ter.*, abridgment of the 12th chapter of the first book. *J. S.*

ma rerum proculdubio contrarium invenitur. Itaque longe plura et meliora, atque per minora intervalla, a ratione et industria et directione et intentione hominum speranda sunt, quam a casu et instinctu animalium et hujusmodi, quæ hactenus principium inventis dederunt.

CIX.

Etiam illud ad spem trahi possit, quod nonnulla ex his quæ jam inventa sunt ejus sint generis ut antequam invenirentur haud facile cuiquam in mentem venisset de iis aliquid suspicari; sed plane quis illa ut impossibilia contempsisset. Solent enim homines de rebus novis ad exemplum veterum, et secundum phantasiam ex iis præceptam et inquinatam, hariolari; quod genus opinandi fallacissimum est, quandoquidem multa ex his quæ ex fontibus rerum petuntur per rivulos consuetos non fluant.

Veluti si quis, ante tormentorum igneorum inventionem, rem per effectus descripsisset, atque in hunc modum dixisset: inventum quoddam detectum esse, per quod muri et munitiones quæque maximæ ex longo intervallo concuti et dejici possint; homines sane de viribus tormentorum et machinarum per pondera et rotas et hujusmodi arietationes et impulsus multiplicandis, multa et varia secum cogitaturi fuissent; de vento autem igneo, tam subito et violenter se expandente et exsufflante, vix unquam aliquid alicujus imaginationi aut phantasiæ occursurum fuisset; utpote cujus exemplum in proximo non vidisset,[1] nisi forte in terræ motu aut fulmine, quæ, ut magnalia naturæ et non imitabilia ab homine, homines statim rejecturi fuissent.

[1] As a thing to which he had seen nothing immediately analogous.

Eodem modo si, ante fili bombycini inventionem, quispiam hujusmodi sermonem injecisset: esse quoddam fili genus inventum ad vestium et supellectilis usum, quod filum linteum aut laneum tenuitate et nihilominus tenacitate, ac etiam splendore et mollitie, longe superaret; homines statim aut de serico aliquo vegetabili, aut de animalis alicujus pilis delicatioribus, aut de avium plumis et lanugine, aliquid opinaturi fuissent; verum de vermis pusilli textura, eaque tam copiosa et se renovante et anniversaria, nil fuissent certe commenturi. Quod si quis etiam de vermi verbum aliquod injecisset, ludibrio certe futurus fuisset, ut qui novas aranearum operas somniaret.

Similiter, si ante inventionem acus nauticæ quispiam hujusmodi sermonem intulisset: inventum esse quoddam instrumentum, per quod cardines et puncta cœli exacte capi et dignosci possint; homines statim de magis exquisita fabricatione instrumentorum astronomicorum, ad multa et varia, per agitationem phantasiæ, discursuri fuissent; quod vero aliquid inveniri possit, cujus motus cum cœlestibus tam bene conveniret, atque ipsum tamen ex cœlestibus non esset, sed tantum substantia lapidea aut metallica, omnino incredibile visum fuisset. Atque hæc tamen et similia per tot mundi ætates hominés latuerunt, nec per philosophiam aut artes rationales inventa sunt, sed casu et per occasionem; suntque illius (ut diximus) generis, ut ab iis quæ antea cognita fuerunt plane heterogenea et remotissima sint, ut prænotio aliqua nihil prorsus ad illa conducere potuisset.

Itaque sperandum omnino est, esse adhuc in naturæ sinu multa excellentis usus recondita, quæ nullam cum jam inventis cognationem habent aut parallelismum, sed omnino sita sunt extra vias phantasiæ; quæ tamen

adhuc inventa non sunt; quæ proculdubio per multos sæculorum circuitus et ambages et ipsa quandoque prodibunt, sicut illa superiora prodierunt; sed per viam quam nunc tractamus, propere et subito et simul repræsentari [1] et anticipari possunt.

CX.

Attamen conspiciuntur et alia inventa ejus generis quæ fidem faciant, posse genus humanum nobilia inventa, etiam ante pedes posita, præterire et transilire. Utcunque enim pulveris tormentarii vel fili bombycini vel acus nauticæ vel sacchari vel papyri vel similium inventa quibusdam rerum et naturæ proprietatibus niti videantur, at certe Imprimendi artificium nil habet quod non sit apertum et fere obvium. Et nihilominus homines, non advertentes literarum modulos difficilius scilicet collocari quam literæ per motum manus scribantur, sed hoc interesse, quod literarum moduli semel collocati infinitis impressionibus, literæ autem per manum exaratæ unicæ tantum scriptioni, sufficiant; aut fortasse iterum non advertentes atramentum ita inspissari posse, ut tingat, non fluat; præsertim literis resupinatis et impressione facta desuper; hoc pulcherrimo invento (quod ad doctrinarum propagationem tantum facit) per tot sæcula caruerunt.

Solet autem mens humana, in hoc inventionis curriculo, tam læva sæpenumero et male composita esse,

[1] *I. e.* to be presented at once, before the regular time. Thus Pliny, 31. 2., "Thespiarum fons conceptus mulieribus *repræsentat;*" *i. e.* makes them conceive at once. And Cicero, Ep. ad Fam. v. 16., "neque debemus expectare temporis medicinam, quam *repræsentare* ratione possimus." And again Phil. 2., "Corpus libenter obtulerim, si *repræsentari* morte meâ libertas civitatis potest:" *i. e.* to be recovered at once; or at least the recovery hastened. Many other examples are given by Facciolati, showing that this was a very common use of the word. — *J. S.*

ut primo diffidat, et paulo post se contemnat; atque primo incredibile ei videatur aliquid tale inveniri posse, postquam autem inventum sit, incredibile rursus videatur id homines tamdiu fugere potuisse. Atque hoc ipsum ad spem rite trahitur; superesse nimirum adhuc magnum inventorum cumulum, qui non solum ex operationibus incognitis eruendis, sed et ex jam cognitis transferendis et componendis et applicandis, per eam quam diximus Experientiam literatam deduci possit.

CXI.

Neque illud omittendum ad faciendam spem: reputent (si placet) homines infinitas ingenii, temporis, facultatum expensas, quas homines in rebus et studiis longe minoris usus et pretii collocant; quorum pars quota si ad sana et solida verteretur, nulla non difficultas superari possit. Quod idcirco adjungere visum est, quia plane fatemur Historiæ Naturalis et Experimentalis collectionem, qualem animo metimur et qualis esse debet, opus esse magnum, et quasi regium, et multæ operæ atque impensæ.

CXII.

Interim particularium multitudinem nemo reformidet, quin potius hoc ipsum ad spem revocet. Sunt enim artium et naturæ particularia Phænomena manipuli instar ad ingenii commenta, postquam ab evidentia rerum disjuncta et abstracta fuerint. Atque hujus viæ exitus in aperto est, et fere in propinquo; alterius exitus nullus, sed implicatio infinita. Homines enim adhuc parvam in Experientia moram fecerunt, et eam leviter perstrinxerunt, sed in meditationibus et commentationibus ingenii infinitum tempus

contriverunt. Apud nos vero si esset præsto quispiam qui de facto naturæ ad interrogata responderet,[1] paucorum annorum esset inventio causarum et scientiarum omnium.

CXIII.

Etiam nonnihil hominibus spei fieri posse putamus ab exemplo nostro proprio; neque jactantiæ causa hoc dicimus sed quod utile dictu sit. Si qui diffidant, me videant, hominem inter homines ætatis meæ civilibus negotiis occupatissimum, nec firma admodum valetudine (quod magnum habet temporis dispendium), atque in hac re plane protopirum, et vestigia nullius sequutum, neque hæc ipsa cum ullo mortalium communicantem, et tamen veram viam constanter ingressum et ingenium rebus submittentem, hæc ipsa aliquatenus (ut existimamus) provexisse; et deinceps videant, quid ab hominibus otio abundantibus, atque a laboribus consociatis, atque a temporum successione, post hæc indicia nostra expectandum sit; præsertim in via quæ non singulis solummodo pervia est (ut fit in via illa rationali), sed ubi hominum labores et operæ (præsertim quantum ad experientiæ collectam) optime distribui et deinde componi possint. Tum enim homines vires suas nosse incipient, cum non eadem infiniti, sed alia alii præstabunt.

CXIV.

Postremo, etiamsi multo infirmior et obscurior aura spei ab ista Nova Continente spiraverit,[2] tamen omnino

[1] The allusion is to judicial examination on interrogatories. Naturæ is to be construed with de facto, and not with interrogata. "Interrogata naturæ" cannot be rendered our "interrogations of nature," which is Mr. Wood's translation.

[2] Bacon refers to what Peter Martyr Anghiera has related, that Colum-

experiendum esse (nisi velimus animi esse plane abjecti) statuimus. Non enim res pari periculo non tentatur, et non succedit; cum in illo ingentis boni, in hoc exiguæ humanæ operæ, jactura vertatur. Verum ex dictis, atque etiam ex non dictis, visum est nobis spei abunde subesse, non tantum homini strenuo ad experiendum, sed etiam prudenti et sobrio ad credendum.

CXV.

Atque de desperatione tollenda, quæ inter causas potentissimas ad progressum scientiarum remorandum et inhibendum fuit, jam dictum est. Atque simul sermo de signis et causis errorum, et inertiæ et ignorantiæ quæ invaluit, absolutus est; præsertim cum subtiliores causæ, et quæ in judicium populare aut observationem non incurrunt, ad ea quæ de Idolis animi humani dicta sunt referri debeant.

Atque hic simul pars destruens Instaurationis nostræ claudi debet, quæ perficitur tribus redargutionibus; redargutione nimirum *Humanæ Rationis Nativæ* et sibi permissæ;[1] redargutione *Demonstrationum;* et redargutione *Theoriarum*, sive philosophiarum et doctrinarum quæ receptæ sunt. Redargutio vero earum talis fuit qualis esse potuit; videlicet per signa, et evidentiam causarum; cum confutatio alia nulla a no-

bus observing the west-winds which blow at certain times of the year on the coast of Portugal, came to the conclusion that there must be land to generate them.

[1] For an explanation of this passage, as connected with the first form of the doctrine of Idols when they were divided into *three* kinds to each of which one of these confutations corresponded, see the preface. In comparing it with the corresponding passages in the *Partis secundæ delineatio*, and the *Distributio operis*, it will be observed that the order of the confutations is inverted. The first of these redargutions extends from the 40th to the 60th aphorism; the other two, which are not kept distinct, end here. — *J. S.*

bis (qui et de principiis et de demonstrationibus ab aliis dissentimus) adhiberi potuerit.

Quocirca tempus est, ut ad ipsam artem et normam Interpretandi Naturam veniamus; et tamen nonnihil restat quod prævertendum est. Quum enim in hoc primo Aphorismorum libro illud nobis propositum sit, ut tam ad intelligendum quam ad recipiendum ea quæ sequuntur mentes hominum præparentur; expurgata jam et abrasa et æquata mentis area, sequitur ut mens sistatur in positione bona, et tanquam aspectu benevolo, ad ea quæ proponemus. Valet enim in re nova ad præjudicium, non solum præoccupatio fortis opinionis veteris, sed et præceptio sive præfiguratio falsa rei quæ affertur. Itaque conabimur efficere ut habeantur bonæ et veræ de iis quæ adducimus opiniones, licet ad tempus tantummodo, et tanquam usurariæ,[1] donec res ipsa pernoscatur.

CXVI.

Primo itaque postulandum videtur, ne existiment homines nos, more antiquorum Græcorum, aut quorundam novorum hominum, Telesii, Patricii, Severini,[2] sectam aliquam in philosophia condere velle. Neque enim hoc agimus; neque etiam multum interesse putamus ad hominum fortunas quales quis opiniones abstractas de natura et rerum principiis habeat; neque dubium est, quin multa hujusmodi et vetera

[1] Compare Distr. Op., p. 226.: "At quinta pars ad tempus tantum, donec reliqua perficiantur, adhibetur; et tanquam fœnus redditur usque dum sors haberi possit." See also the next aphorism, in which the same expression occurs.

[2] See *De Aug.* iv. 3. for a rather fuller mention of these philosophers, and the note upon the passage. See also, for Telesius, the preface to *Fabula Cœli et Cupidinis;* for Patricius, the *Descriptio Globi intellectualis;* for Severinus, the *Temperis Partus Masculus.* — *J. S.*

revocari et nova introduci possint; quemadmodum et complura themata cœli supponi possunt, quæ cum phænomenis sat bene conveniunt, inter se tamen dissentiunt.

At nos de hujusmodi rebus opinabilibus, et simul inutilibus, non laboramus. At contra nobis constitutum est experiri, an revera potentiæ et amplitudinis humanæ firmiora fundamenta jacere ac fines in latius proferre possimus. Atque licet sparsim et in aliquibus subjectis specialibus, longe veriora habeamus et certiora (ut arbitramur) atque etiam magis fructuosa quam quibus homines adhuc utuntur, (quæ in quintam Instaurationis nostræ partem congessimus,) tamen theoriam nullam universalem aut integram proponimus. Neque enim huic rei tempus adhuc adesse videtur. Quin nec spem habemus vitæ producendæ ad sextam Instaurationis partem (quæ philosophiæ per legitimam Naturæ Interpretationem inventæ destinata est) absolvendam; sed satis habemus si in mediis sobrie et utiliter nos geramus, atque interim semina veritatis sincerioris in posteros spargamus, atque initiis rerum magnarum non desimus.

CXVII.

Atque quemadmodum sectæ conditores non sumus, ita nec operum particularium largitores aut promissores. Attamen possit aliquis hoc modo occurrere; quod nos, qui tam sæpe operum mentionem faciamus et omnia eo trahamus, etiam operum aliquorum pignora exhibeamus. Verum via nostra et ratio (ut sæpe perspicue diximus et adhuc dicere juvat) ea est; ut non opera ex operibus sive experimenta ex experimentis (ut empirici), sed ex operibus et experimentis

causas et axiomata, atque ex causis et axiomatibus rursus nova opera et experimenta (ut legitimi Naturæ Interpretes), extrahamus.

Atque licet in tabulis nostris inveniendi (ex quibus quarta pars Instaurationis consistit), atque etiam exemplis particularium (quæ in secunda parte adduximus), atque insuper in observationibus nostris super historiam (quæ in tertia parte operis descripta est), quivis vel mediocris perspicaciæ et solertiæ complurium operum nobilium indicationes et designationes ubique notabit; ingenue tamen fatemur, historiam naturalem quam adhuc habemus, aut ex libris aut ex inquisitione propria, non tam copiosam esse et verificatam, ut legitimæ Interpretationi satisfacere aut ministrare possit.

Itaque si quis ad mechanica sit magis aptus et paratus, atque sagax ad venanda opera [1] ex conversatione sola cum experimentis, ei permittimus et relinquimus illam industriam, ut ex historia nostra et tabulis multa tanquam in via decerpat et applicet ad opera, ac veluti fœnus recipiat ad tempus, donec sors haberi possit. Nos vero, cum ad majora contendamus, moram omnem præproperam et præmaturam in istiusmodi rebus tanquam Atalantæ pilas (ut sæpius solemus dicere) damnamus. Neque enim aurea poma pueriliter affectamus, sed omnia in victoria cursus artis super naturam ponimus; neque muscum aut segetem herbidam demetere festinamus, sed messem tempestivam expectamus.

CXVIII.

Occurret etiam alicui proculdubio, postquam ipsam

[1] Compare *Temporis Partus Masculus*: — "Siquidem utile genus eorum est qui de theoriis non admodum soliciti, mechanicâ quadam subtilitate rerum inventarum extensiones prehendunt; qualis est Bacon." — *J. S.*

historiam nostram et inventionis tabulas perlegerit, aliquid in ipsis experimentis minus certum, vel omnino falsum; atque propterea secum fortasse reputabit, fundamentis et principiis falsis et dubiis inventa nostra niti. Verum hoc nihil est; necesse enim est talia sub initiis evenire. Simile enim est ac si in scriptione aut impressione una forte litera aut altera perperam posita aut collocata sit; id enim legentem non multum impedire solet, quandoquidem errata ab ipso sensu facile corriguntur. Ita etiam cogitent homines multa in historia naturali experimenta falso credi et recipi posse, quæ paulo post a causis et axiomatibus inventis facile expunguntur et rejiciuntur. Sed tamen verum est, si in historia naturali et experimentis magna et crebra et continua fuerint errata, illa nulla ingenii aut artis fœlicitate corrigi aut emendari posse. Itaque si in historia nostra naturali, quæ tanta diligentia et severitate et fere religione probata et collecta est, aliquid in particularibus quandoque subsit falsitatis aut erroris, quid tandem de naturali historia vulgari, quæ præ nostra tam negligens est et facilis, dicendum erit? aut de philosophia et scientiis super hujusmodi arenas (vel syrtes potius) ædificatis? Itaque hoc quod diximus neminem moveat.

CXIX.

Occurrent etiam in historia nostra et experimentis plurimæ res, primo leves et vulgatæ, deinde viles et illiberales, postremo nimis subtiles ac mere speculativæ, et quasi nullius usus: quod genus rerum, hominum studia avertere et alienare possit.

Atque de istis rebus quæ videntur vulgatæ, illud homines cogitent; solere sane eos adhuc nihil aliud agere, quam ut eorum quæ rara sunt causas ad ea quæ

frequenter fiunt referant et accommodent, at ipsorum quæ frequenter eveniunt nullas causas inquirant, sed ea ipsa recipiant tanquam concessa et admissa.

Itaque non ponderis, non rotationis cœlestium, non caloris, non frigoris, non luminis, non duri, non mollis, non tenuis, non densi, non liquidi, non consistentis, non animati, non inanimati, non similaris, non dissimilaris, nec demum organici, causas quærunt; sed illis, tanquam pro evidentibus et manifestis, receptis, de ceteris rebus quæ non tam frequenter et familiariter occurrunt disputant et judicant.

Nos vero, qui satis scimus nullum de rebus raris aut notabilibus judicium fieri posse, multo minus res novas in lucem protrahi, absque vulgarium rerum causis et causarum causis rite examinatis et repertis, necessario ad res vulgarissimas in historiam nostram recipiendas compellimur. Quinetiam nil magis philosophiæ offecisse deprehendimus quam quod res quæ familiares sunt et frequenter occurrunt contemplationem hominum non morentur et detineant, sed recipiantur obiter, neque earum causæ quæri soleant: ut non sæpius requiratur informatio de rebus ignotis, quam attentio in notis.

CXX.

Quod vero ad rerum vilitatem attinet, vel etiam turpitudinem, quibus (ut ait Plinius) honos præfandus est;[1] eæ res, non minus quam lautissimæ et pretiosissimæ, in historiam naturalem recipiendæ sunt. Neque propterea polluitur naturalis historia: sol enim æque palatia et cloacas ingreditur, neque tamen polluitur.

[1] "Rerum natura, hoc est, vita narratur, et hæc sordidissimâ sui parte, ut plurimarum rerum aut rusticis vocabulis aut externis, imo barbaris, etiam cum honoris præfatione ponendis." — Plin. *Hist. Nat.* i. ad init. Compare also Aristot. *De Part. Animal.* i. 5.

Nos autem non Capitolium aliquod aut Pyramidem hominum superbiæ dedicamus aut condimus, sed templum sanctum ad exemplar mundi in intellectu humano fundamus. Itaque exemplar sequimur. Nam quicquid essentia dignum est, id etiam scientia dignum, quæ est essentiæ imago. At vilia æque subsistunt ac lauta. Quinetiam, ut e quibusdam putridis materiis, veluti musco et zibetho, aliquando optimi odores generantur; ita et ab instantiis vilibus et sordidis quandoque eximia lux et informatio emanat. Verum de hoc nimis multa; cum hoc genus fastidii sit plane puerile et effœminatum.

CXXI.

At de illo omnino magis accurate dispiciendum; quod plurima in historia nostra captui vulgari, aut etiam cuivis intellectui (rebus præsentibus assuefacto), videbuntur curiosæ cujusdam et inutilis subtilitatis. Itaque de hoc ante omnia et dictum et dicendum est; hoc scilicet; nos jam sub initiis et ad tempus, tantum *lucifera* experimenta, non *fructifera* quærere; ad exemplum creationis divinæ, quod sæpius diximus, quæ primo die lucem tantum produxit, eique soli unum integrum diem attribuit, neque illo die quicquam materiati operis immiscuit.

Itaque si quis istiusmodi res nullius esse usus putet, idem cogitat ac si nullum etiam lucis esse usum censeat, quia res scilicet solida aut materiata non sit. Atque revera dicendum est, simplicium naturarum cognitionem bene examinatam et definitam instar lucis esse; quæ ad universa operum penetralia aditum præbet, atque tota agmina operum et turmas, et axiomatum nobilissimorum fontes, potestate quadam complectitur et post se trahit; in se tamen non ita magni usus est.

Quin et literarum elementa per se et separatim nihil significant nec alicujus usus sunt, sed tamen ad omnis sermonis compositionem et apparatum instar materiæ primæ sunt. Etiam semina rerum potestate valida, usu (nisi in processu suo) nihili sunt. Atque lucis ipsius radii dispersi, nisi coeant, beneficium suum non impertiuntur.

Quod si quis subtilitatibus speculativis offendatur, quid de scholasticis viris dicendum erit, qui subtilitatibus immensum indulserunt? quæ tamen subtilitates in verbis, aut saltem vulgaribus notionibus (quod tantundem valet), non in rebus aut natura consumptæ fuerunt, atque utilitatis expertes erant, non tantum in origine, sed etiam in consequentiis; tales autem non fuerunt, ut haberent in præsens utilitatem nullam, sed per consequens infinitam; quales sunt eæ de quibus loquimur. Hoc vero sciant homines pro certo, omnem subtilitatem disputationum et discursuum mentis, si adhibeatur tantum post axiomata inventa, seram esse et præposteram; et subtilitatis tempus verum ac proprium, aut saltem præcipuum, versari in pensitanda experientia et inde constituendis axiomatibus; nam illa altera subtilitas naturam prensat et captat, sed nunquam apprehendit aut capit. Et verissimum certe est quod de occasione sive fortuna dici solet, si transferatur ad naturam: videlicet, *eam a fronte comatam, ab occipitio calvam esse.*

Denique de contemptu in naturali historia rerum aut vulgarium, aut vilium, aut nimis subtilium et in originibus suis inutilium, illa vox mulierculæ ad tumidum principem, qui petitionem ejus ut rem indignam et majestate sua inferiorem abjecisset, pro oraculo sit; *Desine ergo rex esse:* quia certissimum est, impe-

rium in naturam, si quis hujusmodi rebus ut nimis exilibus et minutis vacare nolit, nec obtineri nec geri posse.

CXXII.

Occurrit[1] etiam et illud; mirabile quiddam esse et durum, quod nos omnes scientias atque omnes authores simul ac veluti uno ictu et impetu summoveamus: idque non assumpto aliquo ex antiquis in auxilium et præsidium nostrum, sed quasi viribus propriis.

Nos autem scimus, si minus sincera fide agere voluissemus, non difficile fuisse nobis, ista quæ afferuntur vel ad antiqua sæcula ante Græcorum tempora (cum scientiæ de natura magis fortasse sed tamen majore cum silentio floruerint, neque in Græcorum tubas et fistulas adhuc incidissent), vel etiam (per partes certe) ad aliquos ex Græcis ipsis referre, atque astipulationem et honorem inde petere: more novorum hominum, qui nobilitatem sibi ex antiqua aliqua prosapia, per genealogiarum favores, astruunt et affingunt. Nos vero rerum evidentia freti, omnem commenti et imposturæ conditionem rejicimus; neque ad id quod agitur plus interesse putamus, utrum quæ jam invenientur antiquis olim cognita, et per rerum vicissitudines et sæcula occidentia et orientia sint, quam hominibus curæ esse debere, utrum Novus Orbis fuerit insula illa Atlantis et veteri mundo cognita, an nunc primum reperta. Rerum enim inventio a naturæ luce petenda, non ab antiquitatis tenebris repetenda est.

Quod vero ad universalem istam reprehensionem attinet, certissimum est vere rem reputanti, eam et magis probabilem esse et magis modestam, quam si facta fuisset ex parte. Si enim in primis notionibus errores radi-

[1] So in the original edition. I think it should be *occurret*. — *J. S.*

cati non fuissent, fieri non potuisset quin nonnulla recte inventa alia perperam inventa correxissent. Sed cum errores fundamentales fuerint, atque ejusmodi ut homines potius res neglexerint ac præterierint, quam de illis pravum aut falsum judicium fecerint; minime mirum est, si homines id non obtinuerint quod non egerint, nec ad metam pervenerint quam non posuerint aut collocarint, neque viam emensi sint quam non ingressi sint aut tenuerint.

Atque insolentiam rei quod attinet; certe si quis manus constantia atque oculi vigore lineam magis rectam aut circulum magis perfectum se describere posse quam alium quempiam sibi assumat, inducitur scilicet facultatis comparatio: quod si quis asserat se adhibita regula aut circumducto circino lineam magis rectam aut circulum magis perfectum posse describere, quam aliquem alium vi sola oculi et manus, is certe non admodum jactator fuerit. Quin hoc quod dicimus non solum in hoc nostro conatu primo et incœptivo locum habet; sed etiam pertinet ad eos qui huic rei posthac incumbent. Nostra enim via inveniendi scientias exæquat fere ingenia, et non multum excellentiæ eorum relinquit: cum omnia per certissimas regulas et demonstrationes transigat. Itaque hæc nostra (ut sæpe diximus) fœlicitatis cujusdam sunt potius quam facultatis, et potius temporis partus quam ingenii. Est enim certe casus aliquis non minus in cogitationibus humanis, quam in operibus et factis.

CXXIII.

Itaque dicendum de nobis ipsis quod ille per jocum dixit, præsertim cum tam bene rem secet: *fieri non potest ut idem sentiant, qui aquam et qui vinum bibant.*

At cæteri homines, tam veteres quam novi, liquorem biberunt crudem in scientiis, tanquam aquam vel sponte ex intellectu manantem, vel per dialecticam, tanquam per rotas ex puteo, haustam. At nos liquorem bibimus et propinamus ex infinitis confectam uvis, iisque maturis et tempestivis, et per racemos quosdam collectis ac decerptis, et subinde in torculari pressis, ac postremo in vase repurgatis et clarificatis. Itaque nil mirum si nobis cum aliis non conveniat.

CXXIV.

Occurret proculdubio et illud: nec metam aut scopum scientiarum a nobis ipsis (id quod in aliis reprehendimus) verum et optimum præfixum esse. Esse enim contemplationem veritatis omni operum utilitate et magnitudine digniorem et celsiorem: longam vero istam et sollicitam moram in experientia et materia et rerum particularium fluctibus, mentem veluti humo affigere, vel potius in Tartarum quoddam confusionis et perturbationis dejicere; atque ab abstractæ sapientiæ serenitate et tranquillitate (tanquam a statu multo diviniore) arcere et summovere. Nos vero huic rationi libenter assentimur; et hoc ipsum, quod innuunt ac præoptant, præcipue atque ante omnia agimus. Etenim verum exemplar mundi in intellectu humano fundamus; quale invenitur, non quale cuipiam sua propria ratio dictaverit. Hoc autem perfici non potest, nisi facta mundi dissectione atque anatomia diligentissima. Modulos vero ineptos mundorum et tanquam simiolas, quas in philosophiis phantasiæ hominum extruxerunt, omnino dissipandas edicimus. Sciant itaque homines (id quod superius diximus) quantum intersit inter humanæ mentis Idola, et divinæ mentis Ideas.

Illa enim nihil aliud sunt quam abstractiones ad placitum: hæ autem sunt vera signacula Creatoris super creaturas, prout in materia per lineas veras et exquisitas imprimuntur et terminantur. Itaque ipsissimæ res sunt (in hoc genere) veritas et utilitas:[1] atque opera ipsa pluris facienda sunt, quatenus sunt veritatis pignora, quam propter vitæ commoda.

CXXV.

Occurret fortasse et illud: nos tanquam actum agere, atque antiquos ipsos eandem quam nos viam tenuisse. Itaque verisimile putabit quispiam etiam nos, post tantum motum et molitionem, deventuros tandem ad aliquam ex illis philosophiis quæ apud antiquos valuerunt. Nam et illos in meditationum suarum principiis vim et copiam magnam exemplorum et particularium para-

[1] Compare *Partis Instaurationis Secundæ Delineatio:* — "Quinetiam illis quibus in contemplationis amorem effusis frequens apud nos operum mentio asperum quiddam et ingratum et mechanicum sonat, monstrabimus quantum illi desideriis suis propriis adversentur, cum *puritas contemplationum* atque *substructio et inventio operum* prorsus *eisdem rebus nitantur* et simul perfruantur." In a corresponding passage in the *Cogitata et Visa* we find, instead of the last clause, "etenim in naturâ Opera non tantum vitæ beneficia sed et veritatis pignora esse. . . Veritatem enim per Operum indicationem magis quam ex argumentatione aut etiam ex sensu et patefieri et probari. Quare *unam eandemque rationem et conditionis humanæ et mentis dotandæ* esse."

Compare also *Nov. Org.* ii. 4.: "Ista autem duo pronuntiata, Activum et Contemplativum, *res eadem sunt;* et quòd in operando utilissimum id in sciendo verissimum."

I do not think that the use of *ipsissimæ* here can be justified: if the meaning be (as I think it must) that truth and utility are (in this kind) "the very same things." If *ipsissimæ* be used correctly, the meaning must be that things themselves, the very facts of nature, *are* truth and utility both. But in that case we should expect "*et* veritas et utilitas." Mr. Ellis proposes to render the phrase thus: "Truth and utility are in this kind the very things we seek for." But to me it seems less probable that Bacon would have expressed such a meaning by such a phrase than that he used the word *ipsissimæ* incorrectly in the sense I have attributed to it. — *J. S.*

visse, atque in commentarios per locos et titulos digessisse, atque inde philosophias suas et artes confecisse, et postea, re comperta, pronuntiasse, et exempla ad fidem et docendi lumen sparsim addidisse; sed particularium notas et codicillos ac commentarios suos in lucem edere supervacuum et molestum putasse; ideoque fecisse quod in ædificando fieri solet, nempe post ædificii structuram machinas et scalas a conspectu amovisse. Neque aliter factum esse credere certe oportet. Verum nisi quis omnino oblitus fuerit eorum quæ superius dicta sunt, huic objectioni (aut scrupulo potius) facile respondebit. Formam enim inquirendi et inveniendi apud antiquos et ipsi profitentur,[1] et scripta eorum præ se ferunt. Ea autem non alia fuit, quam ut ab exemplis quibusdam et particularibus (additis notionibus communibus, et fortasse portione nonnulla ex opinionibus receptis quæ maxime placuerunt) ad conclusiones maxime generales sive principia scientiarum advolarent, ad quorum veritatem immotam et fixam conclusiones inferiores per media educerent ac probarent; ex quibus artem constituebant. Tum demum si nova particularia et exempla mota essent et adducta quæ placitis suis refragarentur, illa aut per distinctiones aut per regularum suarum explanationes in ordinem subtiliter redigebant, aut demum per exceptiones grosso modo summovebant: at rerum particularium non refragantium causas ad illa principia sua laboriose et pertinaciter accommodabant. Verum nec historia naturalis et experientia illa erat, quam fuisse oportebat, (longe certe abest,) et ista advolatio ad generalissima omnia perdidit.

[1] "Profitemur" in the original edition; obviously a misprint. Compare the corresponding passage in *Inquisitio legitima de Motu.*

CXXVI.

Occurret et illud: nos, propter inhibitionem quandam pronuntiandi et principia certa ponendi donec per medios gradus ad generalissima rite perventum sit, suspensionem quandam judicii tueri, atque ad Acatalepsiam rem deducere. Nos vero non *Acatalepsiam*, sed *Eucatalepsiam* meditamur et proponimus: sensui enim non derogamus, sed ministramus; et intellectum non contemnimus, sed regimus. Atque melius est scire quantum opus sit, et tamen nos non penitus scire putare, quam penitus scire nos putare, et tamen nil eorum quæ opus est scire.

CXXVII.

Etiam dubitabit quispiam, potius quam objiciet, utrum nos de Naturali tantum Philosophia, an etiam de scientiis reliquis, Logicis, Ethicis, Politicis, secundum viam nostram perficiendis loquamur. At nos certe de universis hæc quæ dicta sunt intelligimus: atque quemadmodum vulgaris logica, quæ regit res per Syllogismum, non tantum ad naturales, sed ad omnes scientias pertinet; ita et nostra, quæ procedit per Inductionem, omnia complectitur. Tam enim historiam et tabulas inveniendi conficimus de Ira, Metu, et Verecundia, et similibus; ac etiam de exemplis rerum Civilium: nec minus de motibus mentalibus Memoriæ, Compositionis et Divisionis,[1] Judicii, et reliquorum: quam de Calido et Frigido, aut Luce, aut Vegetatione, aut similibus.[2] Sed tamen cum nostra ratio Interpretandi,

[1] Synthesis and analysis?

[2] This passage is important because it shows that Bacon proposed to apply his method to mental phenomena; which is in itself a sufficient refutation of M. Cousin's interpretation of the passage in which, when censuring

post historiam præparatam et ordinatam, non mentis tantum motus et discursus (ut logica vulgaris), sed et rerum naturam intueatur; ita mentem regimus, ut ad rerum naturam se, aptis per omnia modis, applicare possit. Atque propterea multa et diversa in doctrina Interpretationis præcipimus, quæ ad subjecti de quo inquirimus qualitatem et conditionem, modum inveniendi nonnulla ex parte applicent.

CXXVIII.

At illud de nobis ne dubitare quidem fas sit; utrum nos philosophiam et artes et scientias quibus utimur destruere et demoliri cupiamus: contra enim, earum et usum et cultum et honores libenter amplectimur. Neque enim ullo modo officimus, quin istæ quæ invaluerunt et disputationes alant, et sermones ornent, et ad professoria munera ac vitæ civilis compendia adhibeantur et valeant; denique, tanquam numismata quædam, consensu inter homines recipiantur. Quinetiam significamus aperte, ea quæ nos adducimus ad istas res non multum idonea futura; cum ad vulgi captum deduci omnino non possint, nisi per effecta et opera tantum. At hoc ipsum quod de affectu nostro et bona voluntate erga scientias receptas dicimus quam vere profiteamur, scripta nostra in publicum edita (præsertim libri de Progressu Scientiarum) fidem faciant. Ita que id verbis amplius vincere non conabimur. Illud interim constanter et diserte monemus; his modis qui in usu sunt nec magnos in scientiarum doctrinis et contemplatione progressus fieri, nec illas ad amplitudinem operum deduci posse.

the writings of the schoolmen, he compares them to the self-evolved web of the spider. I have elsewhere spoken more at length of this passage. [See p. 161.]

CXXIX.

Superest ut de Finis excellentia pauca dicamus. Ea si prius dicta fuissent, votis similia videri potuissent: sed spe jam facta, et iniquis præjudiciis sublatis, plus fortasse ponderis habebunt. Quod si nos omnia perfecissemus et plane absolvissemus, nec alios in partem et consortium laborum subinde vocaremus, etiam ab hujusmodi verbis abstinuissemus, ne acciperentur in prædicationem meriti nostri. Cum vero aliorum industria acuenda sit et animi excitandi atque accendendi, consentaneum est ut quædam hominibus in mentem redigamus.

Primo itaque videtur inventorum nobilium introductio inter actiones humanas longe primas partes tenere: id quod antiqua sæcula judicaverunt. Ea enim rerum inventoribus divinos honores tribuerunt; iis autem qui in rebus civilibus merebantur (quales erant urbium et imperiorum conditores, legislatores, patriarum a diuturnis malis liberatores, tyrannidum debellatores, et his similes), heroum tantum honores decreverunt. Atque certe si quis ea recte conferat, justum hoc prisci sæculi judicium reperiet. Etenim inventorum beneficia ad universum genus humanum pertinere possunt, civilia ad certas tantummodo hominum sedes: hæc etiam non ultra paucas ætates durant, illa quasi perpetuis temporibus. Atque status emendatio in civilibus non sine vi et perturbatione plerumque procedit: at inventa beant, et beneficium deferunt absque alicujus injuria aut tristitia.

Etiam inventa quasi novæ creationes sunt, et divinorum operum imitamenta; ut bene cecinit ille:

"Primum frugiferos fœtus mortalibus ægris
Dididerant quondam præstanti nomine Athenæ;
Et RECREAVERUNT vitam, legesque rogarunt."[1]

Atque videtur notatu dignum in Solomone; quod cum imperio, auro, magnificentia operum, satellitio, famulitio, classe insuper, et nominis claritate, ac summa hominum admiratione floreret, tamen nihil horum delegerit sibi ad gloriam, sed ita pronuntiaverit: *Gloriam Dei esse, celare rem; gloriam regis, investigare rem.*[2]

Rursus (si placet) reputet quispiam, quantum intersit inter hominum vitam in excultissima quapiam Europæ provincia, et in regione aliqua Novæ Indiæ maxime fera et barbara: ea[3] tantum differre existimabit, ut merito *hominem homini Deum esse*, non solum propter auxilium et beneficium, sed etiam per status comparationem, recte dici possit. Atque hoc non solum, non cœlum, non corpora, sed artes præstant.

Rursus, vim et virtutem et consequentias rerum inventarum notare juvat: quæ non in aliis manifestius occurrunt, quam in illis tribus quæ antiquis incognitæ, et quarum primordia, licet recentia, obscura et ingloria sunt: Artis nimirum Imprimendi, Pulveris Tormentarii, et Acus Nauticæ. Hæc enim tria rerum faciem et statum in orbe terrarum mutaverunt: primum, in re literaria; secundum, in re bellica; tertium, in navigationibus: unde innumeræ rerum mutationes sequutæ sunt; ut non imperium aliquod, non secta, non stella, majorem efficaciam et quasi influxum super res humanas exercuisse videatur, quam ista mechanica exercuerunt.

Præterea non abs re fuerit, tria hominum ambitionis

[1] Lucretius, vi. 1–3. [2] Prov. xxv. 2. [3] So in the original edition.

genera et quasi gradus distinguere. Primum eorum, qui propriam potentiam in patria sua amplificare cupiunt; quod genus vulgare est et degener. Secundum eorum, qui patriæ potentiam et imperium inter humanum genus amplificare nituntur; illud plus certe habet dignitatis, cupiditatis haud minus. Quod si quis humani generis ipsius potentiam et imperium in rerum universitatem instaurare et amplificare conetur, ea proculdubio ambitio (si modo ita vocanda sit) reliquis et sanior est et augustior. Hominis autem imperium in res, in solis artibus et scientiis ponitur. Naturæ enim non imperatur, nisi parendo.

Præterea, si unius alicujus particularis inventi utilitas ita homines affecerit, ut eum qui genus humanum universum beneficio aliquo devincire potuerit homine majorem putaverint; quanto celsius videbitur tale aliquid invenire, per quod alia omnia expedite inveniri possint? Et tamen (ut verum omnino dicamus) quemadmodum luci magnam habemus gratiam, quod per eam vias inire, artes exercere, legere, nos invicem dignoscere possimus; et nihilominus ipsa visio lucis res præstantior est et pulchrior, quam multiplex ejus usus: ita certe ipsa contemplatio rerum prout sunt, sine superstitione aut impostura, errore aut confusione, in seipsa magis digna est, quam universus inventorum fructus.[1]

Postremo siquis depravationem scientiarum et artium ad malitiam et luxuriam et similia objecerit; id neminem moveat. Illud enim de omnibus mundanis bonis dici potest, ingenio, fortitudine, viribus, forma, divitiis, luce ipsa, et reliquis. Recuperet modo genus humanum jus suum in naturam quod ei ex dotatione divina com-

[1] This is one of the passages which show how far Bacon was from what is now called a utilitarian.

petit, et detur ei copia: usum vero recta ratio et sana religio gubernabit.

CXXX.

Jam vero tempus est ut artem ipsam Interpretandi Naturam proponamus: in qua licet nos utilissima et verissima præcepisse arbitremur, tamen necessitatem ei absolutam (ac si absque ea nil agi possit) aut etiam perfectionem non attribuimus. Etenim in ea opinione sumus; si justam Naturæ et Experientiæ Historiam præsto haberent homines, atque in ea sedulo versarentur, sibique duas res imperare possent; unam, ut receptas opiniones et notiones deponerent; alteram, ut mentem a generalissimis et proximis ab illis ad tempus cohiberent; fore ut etiam vi propria et genuina mentis, absque alia arte, in formam nostram Interpretandi incidere possent. Est enim Interpretatio verum et naturale opus mentis, demptis iis quæ obstant:[1] sed tamen omnia certe per nostra præcepta erunt magis in procinctu, et multo firmiora.

Neque tamen illis nihil addi posse affirmamus: sed contra, nos, qui mentem respicimus non tantum in facultate propria, sed quatenus copulatur cum rebus, Artem inveniendi cum Inventis adolescere posse, statuere debemus.

[1] Compare *Valerius Terminus*, ch. 22.: — "That it is true that interpretation is the very natural and direct intention, action, and progression of the understanding, delivered from impediments; and that all anticipation is but a deflexion or declination by accident." Also *Adv. of Learn.* (2d book): — "For he that shall attentively observe how the mind doth gather this excellent dew of knowledge, like unto that which the poet speaketh of, *Aërii mellis cœlestia dona*, distilling and contriving it out of particulars natural and artificial, as the flowers of the field and garden, shall find that the mind of herself by nature doth manage and act an induction much better than they describe it." — *J. S.*

LIBER SECUNDUS

APHORISMORUM.

LIBER SECUNDUS

APHORISMORUM

DE

INTERPRETATIONE NATURÆ

SIVE DE

REGNO HOMINIS.

Aphorismus

I.

Super datum corpus novam naturam sive novas naturas generare et superinducere, opus et intentio est humanæ Potentiæ. Datæ autem naturæ Formam, sive differentiam veram, sive naturam naturantem,[1] sive fontem emanationis (ista enim vocabula

[1] This is the only passage in which I have met with the phrase *natura naturans* used as it is here. With the later schoolmen, as with Spinoza, it denotes God considered as the causa immanens of the universe, and therefore, according to the latter at least, not hypostatically distinct from it. (On the Pantheistic tendency occasionally perceptible among the schoolmen, see Neander's Essay on Scotus Erigena in the *Berlin Memoirs.*) Bacon applies it to the Form, considered as the causa immanens of the properties of the body. I regret not having been able to trace the history of this remarkable phrase. It does not occur, I think, in St. Thomas Aquinas, though I have met with it in an index to his *Summa;* the passage referred to containing a quotation from St. Augustine, in which the latter speaks of "ea natura quæ creavit omnes cæteras instituitque naturas." (*V.* St. Aug., *De Trin.* xiv. 9.) Neither does it occur, so far as I am aware, where we might have expected it, in the *De Divisione Naturæ* of Scotus Erigena. Vossius, *De Vitiis Latini Sermonis*, notices its use among the schoolmen, but gives no particular reference.

habemus quæ ad indicationem rei proxime accedunt) invenire, opus et intentio est humanæ Scientiæ.[1] Atque his operibus primariis subordinantur alia opera duo secundaria et inferioris notæ; priori, transformatio corporum concretorum de alio in aliud, intra terminos Possibilis;[2] posteriori, inventio in omni generatione et motu *latentis processus*, continuati ab Efficiente manifesto et materia manifesta usque ad Formam inditam; et inventio similiter *latentis schematismi* corporum quiescentium et non in motu.[3]

II.

Quam infœliciter se habeat scientia humana quæ in usu est, etiam ex illis liquet quæ vulgo asseruntur. Recte ponitur; *Vere scire, esse per Causas scire.* Etiam non male constituuntur causæ quatuor; Materia, Forma, Efficiens, et Finis. At ex his, Causa Finalis tantum abest ut prosit, ut etiam scientias corrumpat, nisi in hominis actionibus; Formæ inventio habetur pro desperata; Efficiens vero et Materia (quales quæruntur et recipiuntur, remotæ scilicet, absque *latenti processu* ad Formam) res perfunctoriæ

[1] See General Preface, § 7. p. 67.

[2] The *possibility* of transmutation, long and strenuously denied, though certainly on no sufficient grounds, is now generally admitted. "There was a time when this fundamental doctrine of the alchemists was opposed to known analogies. It is now no longer so opposed to them, only some stages beyond their present development." — *Faraday, Lectures on Non-Metallic Elements*, p. 106.

[3] In this aphorism Bacon combines the antithesis of corpus and natura, the concrete and the abstract, with the antithesis of power and science, and thus arrives at a quadripartite classification. To translate, as Mr. Craik has done, "natura" by "natural substance" involves the whole subject in confusion.

In the last sentence *continuati* may be translated "continuously carried on." The word is often thus used: as in the dictum "mutatio nil aliud est quam successiva et continuata formæ adquisitio."

sunt et superficiales, et nihili fere ad scientiam veram et activam. Neque tamen obliti sumus nos superius notasse et correxisse errorem mentis humanæ, in deferendo Formis primas essentiæ.[1] Licet enim in natura nihil vere existat præter corpora individua edentia actus puros individuos ex lege; in doctrinis tamen, illa ipsa lex, ejusque inquisitio et inventio atque explicatio, pro fundamento est tam ad sciendum quam ad operandum. Eam autem legem, ejusque paragraphos, Formarum nomine intelligimus;[2] præsertim cum hoc vocabulum invaluerit et familiariter occurrat.

III.

Qui causam alicujus naturæ (veluti albedinis aut caloris) in certis tantum subjectis novit, ejus Scientia imperfecta est; et qui effectum super certas tantum materias (inter eas quæ sunt susceptibiles) inducere potest, ejus Potentia pariter imperfecta est. At qui Efficientem et Materialem causam tantummodo novit (quæ causæ fluxæ sunt, et nihil aliud quam vehicula et causæ Formam deferentes in aliquibus),[3] is ad nova inventa, in materia aliquatenus simili et præparata, pervenire potest, sed rerum terminos altius fixos non movet. At qui Formas novit, is naturæ unitatem in materiis dissimillimis complectitur. Itaque quæ adhuc facta non sunt, qualia nec naturæ vicissitudines

[1] [I. § 51. "Formæ enim commenta animi humani sunt, nisi libeat leges illas actûs Formas appellare."] Translate,—"We have noted and corrected as an error of the human mind the opinion that forms give existence." Bacon alludes to the maxim "forma dat esse."

[2] See General Preface, p. 75. The paragraphs of a law are its sections or clauses. It is difficult to attach any definite meaning to Mr. Wood's translation of paragraphos, "its parallels in each science."

[3] *i. e.* "which are unstable causes, and merely vehicles and causes which convey the form in certain cases."

neque experimentales industriæ neque casus ipse in actum unquam perduxissent, neque cogitationem humanam subitura fuissent, detegere et producere potest. Quare ex Formarum inventione sequitur Contemplatio vera et Operatio libera.

IV.

Licet viæ ad potentiam atque ad scientiam humanam conjunctissimæ sint et fere eædem, tamen propter perniciosam et inveteratam consuetudinem versandi in abstractis, tutius omnino est ordiri et excitare scientias ab iis fundamentis quæ in ordine sunt ad partem activam, atque ut illa ipsa partem contemplativam signet et determinet. Videndum itaque est, ad aliquam naturam super corpus datum generandam et superinducendam, quale quis præceptum aut qualem quis directionem aut deductionem maxime optaret; idque sermone simplici et minime abstruso.

Exempli gratia; si quis argento cupiat superinducere flavum colorem auri aut augmentum ponderis (servatis legibus materiæ[1]), aut lapidi alicui non diaphano diaphaneitatem, aut vitro tenacitatem, aut corpori alicui non vegetabili vegetationem; videndum (inquam) est, quale quis præceptum aut deductionem potissimum sibi dari exoptet. Atque primo, exoptabit aliquis proculdubio sibi monstrari aliquid hujusmodi, quod opere non frustret neque experimento fallat. Secundo, exoptabit quis aliquid sibi præscribi, quod ipsum non astringat et coerceat ad media quædam et modos quosdam operandi particulares. Fortasse enim destituetur, nec habebit facultatem et commoditatem talia media comparandi et procurandi. Quod si sint et alia media et alii modi

[1] That is, with a corresponding decrease of volume.

(præter illud præceptum) progignendæ talis naturæ, ea fortasse ex iis erunt quæ sunt in operantis potestate ; a quibus nihilominus per angustias præcepti excludetur, nec fructum capiet. Tertio, optabit aliquid sibi monstrari, quod non sit æque difficile ac illa ipsa operatio de qua inquiritur, sed propius accedat ad praxin.

Itaque de præcepto vero et perfecto operandi, pronuntiatum erit tale ; *ut sit certum, liberum, et disponens sive in ordine ad actionem.* Atque hoc ipsum idem est cum inventione Formæ veræ. Etenim Forma naturæ alicujus talis est ut, ea posita, natura data infallibiliter sequatur. Itaque adest perpetuo quando natura illa adest, atque eam universaliter affirmat, atque inest omni. Eadem Forma talis est ut, ea amota, natura data infallibiliter fugiat. Itaque abest perpetuo quando natura illa abest, eamque perpetuo abnegat, atque inest soli. Postremo, Forma vera talis est, ut naturam datam ex fonte aliquo essentiæ deducat quæ inest pluribus, et notior est naturæ[1] (ut loquuntur) quam ipsa Forma. Itaque de axiomate vero et perfecto sciendi, pronuntiatum et præceptum tale est; *ut inveniatur natura alia, quæ sit cum natura data convertibilis, et tamen sit limitatio naturæ notioris, instar generis veri.*[2] Ista

[1] See note on *Distrib. Operis*, p. 216.

[2] Let us adopt, for distinctness of expression, the theory commonly known as Boscovich's,—a theory which forms the basis of the ordinary mathematical theories of light, of heat, and of electricity. This theory supposes all bodies to be constituted of inextended atoms or centres of force, each of which attracts or repels and is attracted or repelled by all the rest. All the phenomena of nature are thus ascribed to mechanical forces, and all the differences which can be conceived to exist between two bodies,—gold, say, and silver,—can only arise either from the different configuration of the centres of force, or from the different law by which they act on one another.

Assuming the truth of this theory, the question, why are some bodies transparent and others not so—in other words, what is the essential cause of transparency which is precisely what Bacon would call the form

autem duo pronuntiata, activum et contemplativum, res eadem sunt; et quod in Operando utilissimum, id in Sciendo verissimum.

V.

At præceptum sive axioma de transformatione corporum, duplicis est generis. Primum intuetur corpus, ut turmam sive conjugationem naturarum simplicium: ut in auro hæc conveniunt; quod sit flavum; quod sit ponderosum, ad pondus tale; quod sit malleabile aut ductile, ad extensionem talem; quod non fiat volatile, nec deperdat de quanto suo per ignem; quod fluat fluore tali; quod separetur et solvatur modis talibus; et similiter de cæteris naturis, quæ in auro concurrunt. Itaque hujusmodi axioma rem deducit ex Formis naturarum simplicium. Nam qui Formas et modos novit superinducendi flavi, ponderis, ductilis, fixi, fluoris, solutionum, et sic de reliquis, et eorum graduationes et modos, videbit et curabit ut ista conjungi possint in aliquo corpore, unde sequatur transformatio in aurum.[1]

of transparency, — is to be answered by saying that a certain configuration of the centres of force, combined with the existence of a certain law of force, constitutes such a system that the vibrations of the luminiferous ether pass through it. What this configuration or this law may be, is a question which the present state of mathematical physics does not enable us to answer; but there is no reason *à priori* why in time to come it may not receive a complete solution. If it does, we shall then have arrived at a knowledge, on Boscovich's theory, of the form of transparency. Those who are acquainted with the recent progress of physical science know that questions of this kind, so far from being rejected as the questions of a mere dreamer, are thought to be of the highest interest and importance, and that no inconsiderable advance has already been made towards the solution of some at least among them.

[1] "On pourroit trouver le moyen de contrefaire l'or en sorte qu'il satisferoit à toutes les épreuves qu'on en a jusqu'ici; mais on pourroit aussi découvrir alors une nouvelle manière d'essai, qui donneroit le moyen de distinguer l'or naturel de cet or fait par artifice . . . . nous pourrions avoir une définition plus parfaite de l'or que nous n'en avons présentement." — *Leibnitz, Nouv. Ess. sur l'Entendement*, c. 2.

Atque hoc genus operandi pertinet ad actionem primariam. Eadem enim est ratio generandi naturam unam aliquam simplicem, et plures; nisi quod arctetur magis et restringatur homo in operando, si plures requirantur, propter difficultatem tot naturas coadunandi; quæ non facile conveniunt, nisi per vias naturæ tritas et ordinarias. Utcunque tamen dicendum est, quod iste modus operandi (qui naturas intuetur simplices, licet in corpore concreto) procedat ex iis quæ in natura sunt constantia et æterna et catholica, et latas præbeat potentiæ humanæ vias, quales (ut nunc sunt res) cogitatio humana vix capere aut repræsentare possit.

At secundum genus axiomatis (quod a *latentis processus* inventione pendet) non per naturas simplices procedit, sed per concreta corpora, quemadmodum in natura inveniuntur, cursu ordinario. Exempli gratia; in casu ubi fit inquisitio, ex quibus initiis, et quo modo, et quo processu, aurum aut aliud quodvis metallum aut lapis generetur, a primis menstruis aut rudimentis suis usque ad mineram perfectam; aut similiter, quo processu herbæ generentur, a primis concretionibus succorum in terra, aut a seminibus, usque ad plantam formatam, cum universa illa successione motus, et diversis et continuatis naturæ nixibus; similiter, de generatione ordinatim explicata animalium, ab initu ad partum; et similiter de corporibus aliis.

Enimvero neque ad generationes corporum tantum spectat hæc inquisitio, sed etiam ad alios motus et opificia naturæ. Exempli gratia; in casu ubi fit inquisitio, de universa serie et continuatis actionibus alimentandi, a prima receptione alimenti ad assimilationem perfectam; aut similiter de motu voluntario in animalibus, a prima impressione imaginationis et continuatis nixibus

spiritus usque ad flexiones et motus artuum ; aut de explicato motu linguæ et labiorum et instrumentorum reliquorum usque ad editionem vocum articulatarum. Nam hæc quoque spectant ad naturas concretas, sive collegiatas et in fabrica ; et intuentur veluti consuetudines naturæ particulares et speciales, non leges fundamentales et communes, quæ constituunt Formas. Veruntamen omnino fatendum est, rationem istam videri expeditiorem et magis sitam in propinquo, et spem injicere magis, quam illam primariam.

At pars Operativa similiter, quæ huic parti Contemplativæ respondet, operationem extendit et promovet ab iis quæ ordinario in natura inveniuntur ad quædam proxima, aut a proximis non admodum remota ; sed altiores et radicales operationes super naturam pendent utique ab axiomatibus primariis. Quinetiam ubi non datur homini facultas operandi, sed tantum sciendi, ut in cœlestibus (neque enim ceditur homini operari in cœlestia, aut ea immutare aut transformare), tamen inquisitio facti ipsius sive veritatis rei, non minus quam cognitio causarum et consensuum, ad primaria illa et catholica axiomata de naturis simplicibus (veluti de natura rotationis spontaneæ, attractionis sive virtutis magneticæ, et aliorum complurium quæ magis communia sunt quam ipsa cœlestia) refertur. Neque enim speret aliquis terminare quæstionem utrum in motu diurno revera terra aut cœlum rotet, nisi naturam rotationis spontaneæ prius comprehenderit.

VI.

Latens autem *Processus*, de quo loquimur, longe alia res est quam animis hominum (qualiter nunc obsidentur) facile possit occurrare. Neque enim intelligimus

mensuras quasdam aut signa aut scalas processus in corporibus spectabiles; sed plane processum continuatum, qui maxima ex parte sensum fugit.

Exempli gratia; in omni generatione et transformatione corporum, inquirendum quid deperdatur et evolet, quid maneat, quid accedat; quid dilatetur, quid contrahatur; quid uniatur, quid separetur; quid continuetur, quid abscindatur; quid impellat, quid impediat; quid dominetur, quid succumbat; et alia complura.

Neque hic rursus, hæc tantum in generatione aut transformatione corporum quærenda sunt; sed et in omnibus aliis alterationibus et motibus similiter inquirendum quid antecedat, quid succedat; quid sit incitatius, quid remissius; quid motum præbeat, quid regat; et hujusmodi. Ista vero omnia scientiis (quæ nunc pinguissima Minerva et prorsus inhabili contexuntur) incognita sunt et intacta. Cum enim omnis actio naturalis per minima transigatur, aut saltem per illa quæ sunt minora quam ut sensum feriant,[1] nemo se naturam regere aut vertere posse speret, nisi illa debito modo comprehenderit et notaverit.

VII.

Similiter, inquisitio et inventio *latentis schematismi* in corporibus res nova est, non minus quam inventio *latentis processus* et Formæ.[2] Versamur enim plane

[1] *i. e.* Every natural action depends on the ultimate particles of bodies, or at least on parts too small to strike the sense.

[2] The distinction between the Latent Process and Latent Schematism in the absolute way in which it is here stated, involves an assumption which the progress of science will probably show to be unfounded; namely, that bodies apparently at rest are so molecularly. Whereas all analogy and the fact that they act on the senses by acting mechanically on certain deferent media combine to show that we ought to consider bodies even at rest as dynamical and not as statical entities. On this view there is no

adhuc in atriis naturæ, neque ad interiora paramus aditum. At nemo corpus datum nova natura dotare vel in novum corpus fœliciter et apposite transmutare potest, nisi corporis alterandi aut transformandi bonam habuerit notitiam. In modos enim vanos incurret, aut saltem difficiles et perversos, nec pro corporis natura in quod operatur. Itaque ad hoc etiam via plane est aperienda et munienda.

Atque in anatomia corporum organicorum (qualia sunt hominis et animalium) opera sane recte et utiliter insumitur, et videtur res subtilis et scrutinium naturæ bonum. At hoc genus anatomiæ spectabile est, et sensui subjectum, et in corporibus tantum organicis locum habet. Verum hoc ipsum obvium quiddam est et in promptu situm, præ anatomia vera schematismi latentis in corporibus quæ habentur pro similaribus:[1] præsertim in rebus specificatis[2] et earum partibus, ut ferri, lapidis; et partibus similaribus plantæ, animalis; veluti radicis, folii, floris, carnis, sanguinis, ossis, etc. At etiam in hoc genere non prorsus cessavit industria humana; hoc ipsum enim innuit separatio

difficulty in understanding the nature of what appear to be spontaneous changes, because every dynamical system carries within itself the seeds of its own decay, except in particular cases; that is, the type of motion so alters, with greater or less rapidity, that the sensible qualities associated with it pass away. The introduction of the idea of unstable equilibrium in connexion with organic chemistry, was a step in the direction which molecular Physics will probably soon take.

[1] *i. e.* that are thought to be of uniform structure — made up of parts similar to one another.

[2] *i. e.* in things that have a specific character. In Bacon's time only certain things were supposed to belong to natural *species*, all others being merely *elementary*. A ruby has a specific character, is *specificatum;* common stone or rock *non ita;* — they are mere modifications of the element earth, &c. A "specific virtue" is a virtue given by a thing's specific character, transcending the qualities of the elements it consists of. [See note on *De Augm.* ii. 3.]

corporum similarium per distillationes et alios solutionum modos, ut dissimilaritas compositi per congregationem partium homogenearum appareat.[1] Quod etiam ex usu est, et facit ad id quod quærimus; licet sæpius res fallax sit; quia complures naturæ separationi imputantur et attribuuntur, ac si prius substitissent in composito, quas revera ignis et calor et alii modi apertionum de novo indunt et superinducunt. Sed et hæc quoque parva pars est operis ad inveniendum Schematismum verum in composito; qui Schematismus res est longe subtilior et accuratior, et ab operibus ignis potius confunditur quam eruitur et elucescit.

Itaque facienda est corporum separatio et solutio, non per ignem certe, sed per rationem et Inductionem veram, cum experimentis auxiliaribus; et per comparationem ad alia corpora, et reductionem ad naturas simplices et earum Formas quæ in composito conveniunt et complicantur; et transeundum plane a Vulcano ad Minervam, si in animo sit veras corporum texturas et Schematismos (unde omnis occulta atque, ut vocant, specifica proprietas et virtus in rebus pendet; unde etiam omnis potentis alterationis et transformationis norma educitur) in lucem protrahere.

Exempli gratia; inquirendum, quid sit in omni corpore spiritus, quid essentiæ tangibilis; atque ille ipse spiritus, utrum sit copiosus et turgeat, an jejunus et paucus; tenuis, aut crassior; magis aëreus, aut igneus; acris, aut deses; exilis, aut robustus; in progressu, aut in regressu; abscissus, aut continuatus; consentiens cum externis et ambientibus, aut dissentiens; etc. Et similiter essentia tangibilis (quæ non pauciores recipit

[1] That the complex structure of the compound may be made apparent by bringing together its several homogeneous parts.

differentias quam spiritus) atque ejus villi et fibræ et omnimoda textura, rursus autem collocatio spiritus per corpoream molem, ejusque pori, meatus, venæ et cellulæ, et rudimenta sive tentamenta corporis organici, sub eandem inquisitionem cadunt. Sed et in his quoque, atque adeo in omni *latentis schematismi* inventione, lux vera et clara ab Axiomatibus primariis immittitur, quæ certe caliginem omnem et subtilitatem discutit.

VIII.

Neque propterea res deducetur ad Atomum, qui præsupponit Vacuum et materiam non fluxam (quorum utrumque falsum est), sed ad particulas veras, quales inveniuntur. Neque rursus est quod exhorreat quispiam istam subtilitatem, ut inexplicabilem; sed contra, quo magis vergit inquisitio ad naturas simplices, eo magis omnia erunt sita in plano et perspicuo; translato negotio a multiplici in simplex, et ab incommensurabili ad commensurabile, et a surdo ad computabile, et ab infinito et vago ad definitum et certum; ut fit in elementis literarum et tonis concentuum. Optime autem cedit inquisitio naturalis, quando physicum terminatur in mathematico. At rursus multitudinem aut fractiones nemo reformidet. In rebus enim quæ per numeros transiguntur, tam facile quis posuerit aut cogitaverit millenarium quam unum, aut millesimam partem unius quam unum integrum.

IX.

Ex duobus generibus axiomatum quæ superius posita sunt, oritur vera divisio philosophiæ et scientiarum; translatis vocabulis receptis (quæ ad indicationem rei proxime accedunt) ad sensum nostrum. Videlicet, ut

inquisitio *Formarum*, quæ sunt (ratione certe, et sua lege[1]) æternæ et immobiles, constituat *Metaphysicam;* inquisitio vero *Efficientis*, et *Materiæ*, et *Latentis Processus*, et *Latentis Schematismi* (quæ omnia cursum naturæ communem et ordinarium, non leges fundamentales et æternas respiciunt) constituat *Physicam:* atque his subordinentur similiter practicæ duæ; Physicæ Mechanica; Metaphysicæ (perpurgato nomine) Magia, propter latas ejus vias et majus imperium in naturam.

X.

Posito itaque doctrinæ scopo, pergendum ad præcepta; idque ordine minime perverso aut perturbato. Atque indicia de Interpretatione Naturæ complectuntur partes in genere duas; primam de educendis aut excitandis axiomatibus ab experientia; secundam de deducendis aut derivandis experimentis novis ab axiomatibus. Prior autem trifariam dividitur; in tres nempe ministrationes; ministrationem ad Sensum, ministrationem ad Memoriam, et ministrationem ad Mentem sive Rationem.[2]

[1] "In principle at least and in their essential law:" meaning that God could change them, but that this change would be above reason and a change of the law of the form, otherwise unchangeable. The phrase is a saving clause. Perhaps we should read "ratione suâ et lege" — in their principle and law.

[2] Compare *Partis secundæ Delineatio;* and for an explanation of the discrepancy see General Preface, § 10. According to the order proposed in the *Delineatio*, the *ministratio ad sensum* was to contain three parts, of which the first two are not mentioned here: namely, 1st, "Quomodo bona notio constituatur et eliciatur, ac quomodo testatio sensus, quæ semper est ex analogia hominis, ad analogiam mundi reducatur et rectificetur;" 2dly, "Quomodo ea quæ sensum effugiunt aut subtilitate totius corporis, aut partium minutiis, aut loci distantia, aut tarditate vel etiam velocitate motus, aut familiaritate objecti, aut aliis, in ordinem sensus redigantur; ac insuper in casu quo adduci non possunt, quid faciendum, atque quomodo huic destitutioni vel per instrumenta, vel per graduum observationem peritam, vel per corporum proportionatorum ex sensibilibus ad insensibilia

Primo enim paranda est Historia Naturalis et Experimentalis, sufficiens et bona; quod fundamentum rei est; neque enim fingendum aut excogitandum, sed inveniendum, quid natura faciat aut ferat.

Historia vero Naturalis et Experimentalis tam varia est et sparsa, ut intellectum confundat et disgreget, nisi sistatur et compareat ordine idoneo. Itaque formandæ sunt Tabulæ et Coordinationes Instantiarum, tali modo et instructione ut in eas agere possit intellectus.

Id quoque licet fiat, tamen intellectus sibi permissus et sponte movens incompetens est et inhabilis ad opificium axiomatum, nisi regatur et muniatur. Itaque tertio, adhibenda est Inductio legitima et vera, quæ ipsa Clavis est Interpretationis. Incipiendum autem est a fine, et retro pergendum ad reliqua.[1]

XI.

Inquisitio Formarum sic procedit; super naturam datam primo facienda est comparentia[2] ad Intellectum omnium Instantiarum notarum, quæ in eadem natura conveniunt, per materias licet dissimillimas. Atque hujusmodi collectio facienda est historice, absque con-

indicationes, vel per alias vias ac substitutiones, sit subveniendum." I suppose Bacon had now determined to transfer these to the third ministration — the *ministratio ad Rationem;* and to treat of them under the heads *adminicula* et *rectificationes* inductionis. See infra, § 21.; and observe that the full exposition of the *Instantiæ supplementi*, and *Instantiæ persecantes* (both of which belong to the second of the two parts above mentioned) was reserved for the section relating to the *adminicula Inductionis.* See §§ 42, 43. — *J. S.*

[1] *i. e.* Of this, which is the last (namely the method of interpretation by induction based on exclusions), we must speak first, and then go back to the other ministrations.

[2] This is properly a law term, and is equivalent to "appearance" in such phrases as "to enter an appearance," &c. It is also said to be used for the vadimonium given to secure an appearance on an appointed day. See Ducange in voc.

templatione præfestina, aut subtilitate aliqua majore. Exempli gratia; in inquisitione de Forma Calidi.

Instantiæ convenientes in natura Calidi.

1. Radii solis, præsertim æstate et meridie.
2. Radii solis reflexi et constipati, ut inter montes, aut per parietes, et maxime omnium in speculis comburentibus.
3. Meteora ignita.
4. Fulmina comburentia.
5. Eructationes flammarum ex cavis montium, etc.
6. Flamma omnis.
7. Ignita solida.
8. Balnea calida naturalia.
9. Liquida ferventia, aut calefacta.
10. Vapores et fumi ferventes, atque aër ipse, qui fortissimum et furentem suscipit calorem, si concludatur; ut in reverberatoriis.[1]
11. Tempestates aliquæ sudæ per ipsam constitutionem aëris, non habita ratione temporis anni.
12. Aër conclusus et subterraneus in cavernis nonnullis, præsertim hyeme.
13. Omnia villosa, ut lana, pelles animalium, et plumagines, habent nonnihil teporis.
14. Corpora omnia, tam solida quam liquida et tam densa quam tenuia (qualis est ipse aër), igni ad tempus approximata.
15. Scintillæ ex silice et chalybe per fortem percussionem.
16. Omne corpus fortiter attritum, ut lapis, lignum, pannus, etc.; adeo ut temones et axes rotarum aliquan-

[1] That is, furnaces in which the flame is made to return on itself by impeding its direct course.

do flammam concipiant; et mos excitandi ignis apud Indos Occidentales fuerit per attritionem.

17. Herbæ virides et humidæ simul conclusæ et contrusæ, ut rosæ, pinsæ[1] in corbibus; adeo ut fœnum, si repositum fuerit madidum, sæpe concipiat flammam.[2]

18. Calx viva, aqua aspersa.

19. Ferrum, cum primo dissolvitur per aquas fortes in vitro, idque absque ulla admotione ad ignem: et stannum similiter, etc., sed non adeo intense.

20. Animalia, præsertim et perpetuo per interiora; licet in insectis calor ob parvitatem corporis non deprehendatur ad tactum.

21. Fimus equinus, et hujusmodi excrementa animalium recentia.

[1] Pisæ in the original edition.

[2] "That seeds when germinating, as they lie heaped in large masses, evolve a considerable degree of heat, is a fact long known from the malting of grain; but the cause of it was incorrectly sought for in a process of fermentation. To Göppert (*Ueber Wärmeentwickelung in der lebenden Pflanze*) is due the merit of having demonstrated that such is not the case, but that the evolution of heat is connected with the process of germination. Seeds of very different chemical composition (of different grains, of Hemp, Clover, *Spergula*, *Brassica*, &c.), made to germinate in quantities of about a pound, became heated, at a temperature of the air of 48°—66°, to 59°—120° Fahr.

"It was likewise shown by Göppert that full-grown plants also, such as Oats, Maize, *Cyperus esculentus*, *Hyoscyamus*, *Sedum acre*, &c., laid together in heaps and covered with bad conductors of heat, cause a thermometer placed among them to rise about 2°—7° (*Spergula* as much as 22°) above the temperature of the air. . . .

"A very great evolution of heat occurs in the blossom of the *Aroideæ*. This is considerable even in our *Arum maculatum*, and according to Dutrochet's researches (*Comptes rendus*, 1839, 695.) rises to 25°—27° above the temperature of the air. But this phenomenon is seen in a far higher degree in *Colocasia odora*, in which plant it has been investigated by Brongniart (*Nouv. Ann. d. Muséum*, iii.). Vrolik and Vriese (*Ann. des Sc. Nat.*, sec. ser. v. 134.), and Van Beek and Bersgma (*Obs. thermo-élect. s. l'élév. de températ. des Fleurs d. Colocas. odor.* 1838). These last observers found the maximum of heat 129°, when the temperature of the air was 79°." — Mohl *On the Vegetable Cell*, translated by Arthur Henfrey, Lond. 1852, pp. 101. and 102.

22. Oleum forte sulphuris et vitrioli exequitur opera caloris, in linteo adurendo.

23. Oleum origani, et hujusmodi, exequitur opera caloris, in adurendis ossibus dentium.

24. Spiritus vini fortis et bene rectificatus exequitur opera caloris; adeo ut, si albumen ovi in eum injiciatur, concrescat et albescat, fere in modum albuminis cocti; et panis injectus torrefiat et incrustetur, ad modum panis tosti.[1]

25. Aromata et herbæ calidæ, ut dracunculus, nasturtium vetus, etc. licet ad manum non sint calida (nec integra, nec pulveres eorum), tamen ad linguam et palatum parum masticata percipiuntur calida, et quasi adurentia.

26. Acetum forte, et omnia acida, in membro ubi non sit epidermis, ut in oculo, lingua, aut aliqua alia parte vulnerata, et cute detecta, dolorem cient, non multum discrepantem ab eo qui inducitur a calido.

27. Etiam frigora acria et intensa inducunt sensum quendam ustionis;

[1] The analogy which Bacon here remarks, arises probably, in the second instance, from the desiccative power due to the strong affinity of alcohol for water. The French chemist Lassaigne found, I believe, that alcohol extracted a red colouring matter from unboiled lobster shells; but I am not aware that the modus operandi has in this case been explained. But by far the most remarkable case of what may be called simulated heat, is furnished by the action of carbonic acid gas on the skin. Of late years baths of this gas have been used medicinally; but M. Boussingault long since remarked the sensation of heat which it produces. He states that at Quindiu in New Granada there are sulphur works, and that at various points nearly pure carbonic acid gas escapes from shallow excavations in the surface, containing, however, a trace of hydro-sulphuric acid; that the temperature of this issuing stream of gas is lower than the external air, but that the sensation is the same as that produced by a hot-air bath of perhaps from 40° to 45° or 48° centigrade (104° to 118° Fahr.). As this effect has not been noticed in carbonic acid gas prepared artificially, it is probable that it requires for its production the gas to be in motion; so that the necessary conditions are not present when the hand is inserted into a jar of the gas.

"Nec Boreæ penetrabile frigus adurit."[1]

28. Alia.

Hanc *Tabulam Essentiæ et Præsentiæ* appellare consuevimus.

XII.

Secundo, facienda est comparentia ad Intellectum Instantiarum quæ natura data privantur: quia Forma (ut dictum est) non minus abesse debet ubi natura abest, quam adesse ubi adest. Hoc nero infinitum esset in omnibus.

Itaque subjungenda sunt negativa affirmativis, et privationes inspiciendæ tantum in illis subjectis quæ sunt maxime cognata illis alteris in quibus natura data inest et comparet. Hanc *Tabulam Declinationis*, sive *Absentiæ in proximo*, appellare consuevimus.

Instantiæ in proximo, quæ privantur natura Calidi.

Ad Instantiam primam *affirmativam*, Instantia prima *negativa* vel subjunctiva.

1. Lunæ et stellarum et cometarum radii non inveniuntur calidi ad tactum:[2] quinetiam observari solent acerrima frigora in pleniluniis. At stellæ fixæ majores, quando sol eas subit aut iis approximatur, existimantur fervores solis augere et intendere; ut fit cum sol sistitur in Leone, et diebus canicularibus.

Ad 2am 2æ.

2. Radii solis in media (quam vocant) regione aëris non calefaciunt; cujus ratio vulgo non male redditur; quia regio illa nec satis appropinquat ad corpus solis, unde radii emanant, nec etiam ad terram, unde reflectuntur. Atque hoc liquet ex fastigiis monti-

[1] Virg. Georg. I. 93.

[2] M. Melloni has recently succeeded in making sensible the moon's calorific rays.

um (nisi sint prælti), ubi nives perpetuo durant. Sed contra notatum est a nonnullis, quod in cacumine Picus de Tenariph, atque etiam in Andis Peruviæ, ipsa fastigia montium nive destituta sint; nivibus jacentibus tantum inferius in ascensu. Atque insuper aër illis ipsis verticibus montium deprehenditur minime frigidus, sed tenuis tantum et acer; adeo ut in Andis pungat et vulneret oculos per nimiam acrimoniam, atque etiam pungat os ventriculi, et inducat vomitum. Atque ab antiquis notatum est, in vertice Olympi tantam fuisse aëris tenuitatem, ut necesse fuerit illis qui eo ascenderant secum deferre spongias aceto et aqua madefactas, easque ad os et nares subinde apponere, quia aër ob tenuitatem non sufficiebat respirationi:[1] in quo vertice etiam relatum est, tantam fuisse serenitatem et tranquillitatem a pluviis et nivibus et ventis, ut sacrificantibus literæ descriptæ digito in cineribus sacrificiorum super aram Jovis, manerent in annum proximum absque ulla perturbatione.[2] Atque etiam hodie ascendentes ad ver-

[1] *i. e.* It was insufficient for the cooling of the blood, which according to Aristotle was the end of respiration.

[2] Aristotle seems to be the first person who mentions this notion. See the *Problems* xxvi. 36.; where however he speaks of Athos and *οἱ τοιοῦτοι*, and not of Olympus. The passages on the subject are to be found in Ideler's *Meteorologia veterum Græcorum et Romanorum* (Berlin, 1832), at p. 81. Compare his edition of the *Meteorologies* of Aristotle, where he has given *in extenso* the passage in which Geminus speaks in the same manner of Mount Cyllene in Arcadia, and also a similar statement made by Philoponus with respect to Olympus. The whole class of stories seem (as Ideler following Lobeck remarks) to have somewhat of a mythical character. G. Bruno apparently confounded Philoponus with Alexander Aphrodisiensis, when in the *Cena di Cenere* he asserted that the latter mentions the sacrifices on the top of Olympus. In the passage on the subject in which we might expect to find him doing so, namely in his Commentary on the *Meteorologies*, i. c. 3., he does not specify any particular mountain.

That there is no wind nor rain on Olympus is mentioned as a common opinion by St. Augustin, *De Civ. Dei*, xvi. 27. Compare Dante, *Purg.* xxviii. 112.

ticem Picus de Tenariph eo vadunt noctu et non interdiu; et paulo post ortum solis monentur et excitantur a ducibus suis ut festinent descendere, propter periculum (ut videtur) a tenuitate aëris, ne solvat spiritus et suffocet.[1]

Ad 2am 3a. Reflexio radiorum solis, in regionibus prope circulos polares, admodum debilis et inefficax invenitur in calore: adeo ut Belgæ, qui hybernarunt in Nova Zembla,[2] cum expectarent navis suæ liberationem et deobstructionem a glaciali mole (quæ eam obsederat) per initia mensis Julii spe sua frustrati sint, et coacti scaphæ se committere. Itaque radii solis directi videntur parum posse, etiam super terram planam; nec reflexi etiam, nisi multiplicentur et uniantur; quod fit cum sol magis vergit ad perpendiculum; quia tum incidentia radiorum facit angulos acutiores, ut lineæ radiorum sint magis in propinquo: ubi contra in magnis obliquitati-

[1] Lest the animal spirits should swoon and be suffocated by the tenuity of the air.

[2] This of course refers to Barentz's expedition in search of a North-East passage. He passed the winter 1596–7 at Nova Zembla. [In Barentz's first voyage, 1594, he was stopped by the ice on the 13th of July, and obliged to return. In his third voyage, 1596, his first considerable check was on the 19th of July; after which he only succeeded in coasting round the northern point of Nova Zembla till the 26th of August, where the ship stuck fast and they were forced to leave her and winter on the island, and return in their boats in the beginning of June 1597. See the letter signed by the company: "Three Voyages by the North-East, &c.," Hackluyt Society, 1853, p. 191. This letter was begun on the 1st of June: "Having till this day stayed for the time and opportunity in hope to get our ship loose, and now are clean out of hope thereof, for that it lieth shut up and enclosed in the ice," &c.: and ended on the 13th, "notwithstanding that while we were making ready to be gone, we had great wind out of the west and north-west, and yet find no alteration nor bettering in the weather, and therefore in the last extremity we left it." This narrative, written by Gerrit de Veer, one of the party, was first published in Dutch in 1598; translated into Latin and French the same year; into Italian in 1599; into English in 1609. See Introduction, p. cxviii. "Per initia mensis *Junii*," would have been more accurate. — *J. S.*]

bus solis anguli sint valde obtusi, et proinde lineæ radiorum magis distantes. Sed interim notandum est, multas esse posse operationes radiorum solis, atque etiam ex natura Calidi, quæ non sunt proportionatæ ad tactum nostrum: adeo ut respectu nostri non operentur usque ad calefactionem, sed respectu aliorum nonnullorum corporum exequantur opera Calidi.

Ad 2am 4a. Fiat hujusmodi experimentum. Accipiatur speculum[1] fabricatum contra ac fit in speculis comburentibus, et interponatur inter manum et radios solis; et fiat observatio, utrum minuat calorem solis, quemadmodum speculum comburens eundem auget et intendit. Manifestum est enim, quoad radios opticos, prout fabricatur speculum in densitate inæquali respectu medii et laterum, ita apparere simulachra magis diffusa aut magis contracta. Itaque idem videndum in calore.

Ad 2am 5a. Fiat experimentum diligenter, utrum per specula comburentia fortissima et optime fabricata radii lunæ possint excipi et colligi in aliquem vel minimum gradum teporis. Is vero gradus teporis si fortasse nimis subtilis et debilis fuerit, ut ad tactum percipi et deprehendi non possit, confugiendum erit ad vitra illa quæ indicant constitutionem aëris calidam aut frigidam; ita ut radii lunæ per speculum comburens incidant et jaciantur in summitatem vitri hujusmodi; atque tum notetur si fiat depressio aquæ per teporem.

Ad 2am 6a. Practicetur etiam vitrum comburens super calidum[2] quod non sit radiosum aut luminosum;[3] ut

[1] "Speculum," used for *lens*. Read "specillum," the common word. *il* passes very easily into *u*; and probably the transition was more facile in the cursive hand.

[2] So in the original; qy. *corpus calidum*. — *J. S.*

[3] Mersenne says the greater number of the experiments mentioned in the second book of the *Novum Organum* had already been made, and mentions

ferri et lapidis calefacti sed non igniti, aut aquæ ferventis, aut similium ; et notetur utrum fiat augmentum et intentio calidi, ut in radiis solis.

Ad 2am 7a. Practicetur etiam speculum comburens in flamma communi.

Ad 2am 8a. Cometarum (si et illos numerare inter meteora libuerit)[1] non deprehenditur constans aut manifestus effectus in augendis ardoribus anni, licet siccitates sæpius inde sequi notatæ sint. Quinetiam trabes et columnæ lucidæ et chasmata et similia apparent sæpius temporibus hybernis quam æstivis ; et maxime per intensissima frigora, sed conjuncta cum siccitatibus. Fulmina tamen et coruscationes et tonitrua raro eveniunt hyeme, sed sub tempus magnorum fervorum. At stellæ (quas vocant) cadentes existimantur vulgo magis constare ex viscosa aliqua materia splendida et accensa, quam esse naturæ igneæ fortioris. Sed de hoc inquiratur ulterius.

Ad 4am 9a. Sunt quædam coruscationes quæ præbent lumen sed non urunt ; eæ vero semper fiunt sine tonitru.

Ad 5um 10a. Eructationes et eruptiones flammarum inveniuntur non minus in regionibus frigidis quam calidis ; ut in Islandia et Groenlaudia ; quemadmodum et arbores per regiones frigidas magis sunt quandoque inflammabiles et magis piceæ ac resinosæ quam per regiones calidas ; ut fit in abiete, pinu, et reliquis ; ve-

particularly, as if he had himself tried it, the reflexion of all kinds of heat by a burning mirror. He also asserts that light is always accompanied by heat. *De la Vérité des Sciences* (1625), p. 210.

[1] That there was no reason for supposing comets to be more than merely meteoric exhalations is the thesis maintained, and doubtless with great ability, by Galileo in his *Saggiatore*, — the true view, or at least a nearer approach to it, having been propounded by the Jesuit Grossi. Bacon perhaps alludes to this controversy.

rum in quali situ et natura soli hujusmodi eruptiones fieri soleant, ut possimus Affirmativæ subjungere Negativam, non satis quæsitum est.

Ad 6am 11a. Omnis flamma perpetuo est calida magis aut minus, neque omnino subjungitur Negativa; et tamen referunt ignem fatuum (quem vocant), qui etiam aliquando impingitur in parietem,[1] non multum habere caloris; fortasse instar flammæ spiritus vini, quæ clemens et lenis est. Sed adhuc lenior videtur ea flamma quæ in nonnullis historiis fidis et gravibus invenitur apparuisse circa capita et comas puerorum et virginum; quæ nullo modo comas adurebat, sed molliter circum eas trepidabat. Atque certissimum est, circa equum in itinere sudantem noctu et suda tempestate apparuisse quandoque coruscationem quandam absque manifesto calore. Atque paucis abhinc annis, notissimum est et pro miraculo quasi habitum gremiale cujusdam puellæ paulo motum aut fricatum coruscasse; quod fortasse factum est ob alumen aut sales quibus gremiale tinctum erat paulo crassius hærentia et incrustata, et ex fricatione fracta. Atque certissimum est saccharum omne, sive conditum (ut vocant) sive simplex, modo sit durius, in tenebris fractum aut cultello scalptum coruscare. Similiter aqua marina et salsa noctu interdum invenitur remis fortiter percussa coruscare. Atque etiam in tempestatibus spuma maris fortiter agitata noctu coruscat; quam coruscationem Hispani *pulmonem marinum* vocant.[2] De illa flamma autem quam anti-

[1] *i. e.* Which sometimes even settles on a wall.

[2] The phrase "pulmo marino" is as much Italian as Spanish, — except of course, that in Italian "pulmo" is replaced by "polmo," — and is merely a translation of *πνεύμων θαλάσσιος*, which is used by Dioscorides, *De Materiâ Medicâ*, ii. 39. The luminous appearance arises apparently from serpent medusæ, which in texture are like the substance of the lungs, from

qui nautæ vocabant *Castorem et Pollucem*, et moderni *Focum Sancti Ermi*,[1] qualem calorem habeat non satis quæsitum est.

Ad 7am 12a. Omne ignitum ita ut vertatur in ruborem igneum etiam sine flamma perpetuo calidum est, neque huic Affirmativæ subjungitur Negativa; sed quod in proximo est videtur esse lignum putre, quod splendet noctu neque tamen deprehenditur calidum; et squamæ piscium putrescentes, quæ etiam splendent noctu, nec inveniuntur ad tactum calidæ; neque etiam corpus cicindelæ aut muscæ (quam vocant Luciolam) calidum ad tactum deprehenditur.

Ad 8am 13a. De balneis calidis, in quo situ et natura soli emanare soleant non satis quæsitum est; itaque non subjungitur Negativa.

Ad 9am 14a. Liquidis ferventibus subjungitur Negativa ipsius liquidi in natura sua. Nullum enim invenitur liquidum tangibile quod sit in natura sua et maneat constanter calidum, sed superinducitur ad tempus tantum calor, ut natura ascititia:[2] adeo ut quæ potestate et operatione sunt maxime calida, ut spiritus vini, olea aromatum chymica, etiam olea vitrioli et sulphuris, et similia, quæ paulo post adurunt, ad primum tactum sint frigida. Aqua autem balneorum naturalium excepta in vas aliquod et separata a fontibus suis defer-

which circumstance they derive the name which Dioscorides gives them. Cf. *De Aug.* IV. 3.

[1] "O lume vivo, que a maritima gente
Tem por santo em tempo de tormenta."
Os Lusiadas de Camoēs, canto v. est. 18.

I take this quotation from Humboldt's *Kosmos*, ii. p. 122.

[2] E converso, calor is *not* a natura adscititia to solids. In modern physics this distinction would be altogether without a meaning. That a hot liquid returns after a while to a cold state, was adduced as an argument for the existence of substantial forms.

vescit perinde ac aqua igne calefacta. At verum est corpora oleosa ad tactum paulo minus esse frigida quam aquea ; ut oleum minus quam aqua, sericum minus quam linteum. Verum hoc pertinet ad *Tabulam Graduum de Frigido.*

Ad 10am 15a. Similiter vapori fervido subjungitur Negativa naturæ ipsius vaporis, qualis apud nos invenitur. Etenim exhalationes ex oleosis, licet facile inflammabiles, tamen non inveniuntur calidæ, nisi a corpore calido recenter exhalaverint.

Ad 10am 16a. Similiter aëri ipsi ferventi subjungitur Negativa naturæ aëris ipsius. Neque enim invenitur apud nos aër calidus ; nisi fuerit aut conclusus, aut attritus, aut manifeste calefactus a sole, igne, aut aliquo alio corpore calido.

Ad 11am 17a. Subjungitur Negativa tempestatum frigidarum magis quam pro ratione temporis anni, quæ eveniunt apud nos flante Euro et Borea ; quemadmodum et contrariæ tempestates eveniunt flante Austro et Zephyro. Etiam inclinatio ad pluviam (præsertim temporibus hyemalibus) comitatur tempestatem tepidam ; at gelu contra frigidam.

Ad 12am 18a. Subjungitur Negativa aëris conclusi in cavernis tempore æstivo. At de aëre concluso omnino diligentius inquirendum. Primo enim non absque causa in dubitationem venit qualis sit natura aëris quatenus ad calidum et frigidum in natura sua propria. Recipit enim aër calidum manifesto ex impressione cœlestium ; frigidum autem fortasse ab expiratione terræ ; et rursus in media (quam vocant) regione aëris a vaporibus frigidis et nivibus ; ut nullum judicium fieri possit de aëris natura per aërem qui foras est et sub dio, sed verius foret judicium per aërem conclusum. Atqui opus est

etiam ut aër concludatur in tali vasi et materia quæ nec ipsa imbuat aërem calido vel frigido ex vi propria nec facile admittat vim aëris extranei. Fiat itaque experimentum per ollam figularem multiplici corio obductam ad muniendam ipsam ab aëre extraneo, facta mora per tres aut quatuor dies in vase bene occluso; deprehensio autem fit post apertionem vasis vel per manum vel per vitrum graduum ordine applicatum.

Ad 13am 19a. Subest similiter dubitatio, utrum tepor in lana et pellibus et plumis et hujusmodi fiat ex quodam exili calore inhærente, quatenus excernuntur ab animalibus; aut etiam ob pinguedinem quandam et oleositatem, quæ sit naturæ congruæ cum tepore; vel plane ob conclusionem et fractionem aëris, ut in articulo præcedente dictum est. Videtur enim omnis aër abscissus a continuitate aëris forinseci habere nonnihil teporis. Itaque fiat experimentum in fibrosis quæ fiunt ex lino; non ex lana aut plumis aut serico, quæ excernuntur ab animatis. Notandum est etiam, omnes pulveres (ubi manifesto includitur aër) minus esse frigidos quam corpora integra ipsorum; quemadmodum etiam existimamus omnem spumam (utpote quæ aërem contineat) minus esse frigidam quam liquorem ipsum.

Ad 14am 20a. Huic non subjungitur Negativa. Nihil enim reperitur apud nos sive tangibile sive spiritale quod admotum igni non excipiat calorem. In eo tamen differunt, quod alia excipiant calorem citius, ut aër, oleum, et aqua; alia tardius, ut lapis et metalla. Verum hoc pertinet ad *Tabulam Graduum*.

Ad 15am 21a. Huic Instantiæ non subjungitur Negativa alia, quam ut bene notetur non excitari scintillas ex silice et chalybe aut alia aliqua substantia dura nisi ubi excutiuntur minutiæ aliquæ ex ipsa substantia lapidis

vel metalli, neque aërem attritum unquam per se generare scintillas, ut vulgo putant; quin et ipsæ illæ scintillæ ex pondere corporis igniti magis vergunt deorsum quam sursum, et in extinctione redeunt in quandam fuliginem corpoream.

Ad 16am 22a. Existimamus huic instantiæ non subjungi Negativam. Nullum enim invenitur apud nos corpus tangibile quod non ex attritione manifesto calescat; adeo ut veteres somniarent non inesse cœlestibus aliam viam aut virtutem calefaciendi nisi ex attritione aëris per rotationem rapidam et incitatam.[1] Verum in hoc genere ulterius inquirendum est utrum corpora quæ emittuntur ex machinis (qualia sunt pilæ ex tormentis) non ex ipsa percussione contrahant aliquem gradum caloris; adeo ut postquam deciderint inveniantur nonnihil calida. At aër motus magis infrigidat quam calefacit; ut in ventis et follibus et flatu oris contracti. Verum hujusmodi motus non est tam rapidus ut excitet calorem, et fit secundum totum, non per particulas; ut mirum non sit, si non generet calorem.

Ad 17am 23a. Circa hanc instantiam facienda est inquisitio diligentior. Videntur enim herbæ et vegetabilia viridia et humida aliquid habere in se occulti caloris. Ille vero calor tam tenuis est ut in singulis non percipiatur ad tactum, verum postquam illa adunata sint

[1] See Arist. Meteorol. I. c. 2. sub finem; or De Cœlo, II. c. 7. It seems probable that Aristotle was influenced by a wish to secure the doctrine of the eternity of the universe, which he saw would be put in peril if celestial heat were ascribed to anything akin to combustion. We now know that the generation of heat, whether by friction, combustion, or otherwise, involves a loss of vis viva, and it is difficult to avoid the conclusion that the material universe sprang, at a finite distance of time ago, out of something wholly and inconceivably different from itself. Nothing is more remarkable than the way in which ontology here forces itself into physics.

et conclusa, ut spiritus ipsorum non expiret in aërem sed se invicem foveat, tum vero oritur calor manifestus, et nonnunquam flamma in materia congrua.

Ad 18am 24a. Etiam circa hanc instantiam diligentior facienda est inquisitio. Videtur enim calx viva aqua aspersa concipere calorem vel propter unionem caloris qui antea distrahebatur (ut ante dictum est de herbis conclusis), vel ob irritationem et exasperationem spiritus ignei ab aqua, ut fiat quidam conflictus et antiperistasis. Utra vero res sit in causa facilius apparebit si loco aquæ immittatur oleum; oleum enim æque ac aqua valebit ad unionem spiritus inclusi, sed non ad irritationem. Etiam faciendum est experimentum latius tam in cineribus et calcibus diversorum corporum, quam per immissionem diversorum liquorum.

Ad 19am 25a. Huic instantiæ subjungitur Negativa aliorum metallorum quæ sunt magis mollia et fluxa. Etenim bracteolæ auri solutæ in liquorem per aquam regis nullum dant calorem ad tactum in dissolutione; neque similiter plumbum in aqua forti; neque etiam argentum vivum (ut memini); sed argentum ipsum parum excitat caloris, atque etiam cuprum (ut memini), sed magis manifesto stannum, atque omnium maxime ferrum et chalybs, quæ non solum fortem excitant calorem in dissolutione, sed etiam violentam ebullitionem.[1] Itaque videtur calor fieri per conflictum, cum aquæ fortes penetrant et fodiunt et divellunt partes corporis, et corpora ipsa resistunt. Ubi vero corpora facilius cedunt vix excitatur calor.

Ad 20am 26a. Calori animalium nulla subjungitur Negativa, nisi insectorum (ut dictum est) ob parvitatem

[1] This ebullition is of course not the *result* of the heat, but arises from the disengagement of gas during the action of the acid on the metal.

corporis. Etenim in piscibus collatis ad animalia terrestria magis notatur gradus caloris quam privatio. In vegetabilibus autem et plantis nullus percipitur gradus caloris ad tactum, neque in lachrymis ipsorum, neque in medullis recenter apertis. At in animalibus magna reperitur diversitas caloris, tum in partibus ipsorum (alius est enim calor circa cor, alius in cerebro, alius circa externa), tum in accidentibus eorum, ut in exercitatione vehementi et febribus.

Ad 21am 27a. Huic instantiæ vix subjungitur Negativa. Quinetiam excrementa animalium non recentia manifeste habent calorem potentialem, ut cernitur in impinguatione soli.

Ad 22am et 23am 28a. Liquores (sive aquæ vocentur sive olea) qui habent magnam et intensam acrimoniam exequuntur opera caloris in divulsione corporum, atque adustione post aliquam moram; sed tamen ad ipsum tactum manus non sunt calidi ab initio. Operantur autem secundum analogiam[1] et poros corporis cui adjunguntur. Aqua enim regis aurum solvit, argentum minime; at contra aqua fortis argentum solvit, aurum minime; neutrum autem solvit vitrum; et sic de cæteris.

Ad 24am 29a. Fiat experimentum spiritus vini in lignis, ac etiam in butyro aut cera aut pice; si forte per calorem suum ea aliquatenus liquefaciat. Etenim instantia 24a ostendit potestatem ejus imitativam caloris in incrustationibus. Itaque fiat similiter experimentum in liquefactionibus. Fiat etiam experimen-

[1] This is another instance of the large sense given to the word analogia. Aqua regia is a mixture of nitric and hydrochloric acids. Its power of dissolving gold is ascribed by Davy to the liberation of chlorine by the mutual action of the two acids. The different result in the case of silver arises from the insolubility of chloride of silver.

tum per vitrum graduum sive calendare quod concavum sit in summitate sua per exterius; et immittatur in illud concavum exterius spiritus vini bene rectificatus, cum operculo ut melius contineat calorem suum; et notetur utrum per calorem suum faciat aquam descendere.

Ad 25am 30a. Aromata, et herbæ acres ad palatum, multo magis sumptæ interius, percipiuntur calida. Videndum itaque in quibus aliis materiis exequantur opera caloris. Atque referunt nautæ, cum cumuli et massæ aromatum diu conclusæ subito aperiuntur, periculum instare illis qui eas primo agitant et extrahunt a febribus et inflammationibus spiritus.[1] Similiter fieri poterit experimentum, utrum pulveres hujusmodi aromatum aut herbarum non arefaciant laridum et carnem suspensam super ipsos, veluti fumus ignis.

Ad 26am 31a. Acrimonia sive penetratio inest tam frigidis, qualia sunt acetum et oleum vitrioli, quam calidis, qualia sunt oleum origani et similia. Itaque similiter et in animatis cient dolorem, et in non animatis divellunt partes et consumunt. Neque huic instantiæ subjungitur Negativa. Atque in animatis nullus reperitur dolor nisi cum quodam sensu caloris.

Ad 27am 32a. Communes sunt complures actiones et calidi et frigidi, licet diversa admodum ratione. Nam et nives puerorum manus videntur paulo post urere; et frigora tuentur carnes a putrefactione, non minus quam ignis; et calores contrahunt corpora in minus, quod faciunt et frigida. Verum hæc et similia opportunius est referre ad Inquisitionem de Frigido.

[1] In the *Annals of Philosophy* a case is mentioned in which the effluvia arising on the opening of a large bark-store at Guayra were sufficiently powerful to cure a bad fever.

XIII.

Tertio facienda est Comparentia ad Intellectum instantiarum in quibus natura de qua fit inquisitio inest secundum magis et minus; sive facta comparatione incrementi et decrementi in eodem subjecto, sive facta comparatione ad invicem in subjectis diversis. Cum enim Forma rei sit ipsissima res; neque differat res a Forma, aliter quam differunt apparens et existens, aut exterius et interius, aut in ordine ad hominem et in ordine ad universum;[1] omnino sequitur ut non recipiatur aliqua natura pro vera Forma, nisi perpetuo decrescat quando natura ipsa decrescit, et similiter perpetuo augeatur quando natura ipsa augetur. Hanc itaque tabulam *Tabulam Graduum* sive *Tabulam Comparativæ* appellare consuevimus.

Tabula Graduum sive *Comparativæ* in Calido.

Primo itaque dicemus de iis quæ nullum prorsus gradum caloris habent ad tactum, sed videntur habere potentialem tantum quendam calorem, sive dispositionem et præparationem ad calidum. Postea demum descendemus ad ea quæ sunt actu sive ad tactum calida, eorumque fortitudines et gradus.

1. In corporibus solidis et tangibilibus non invenitur aliquid quod in natura sua calidum sit originaliter. Non enim lapis aliquis, non metallum, non sulphur, non fossile aliquod, non lignum, non aqua, non cadaver animalis, inveniuntur calida. Aquæ autem

[1] "Res" is to be taken in a general sense, so as to include not only substances, but also what Bacon calls naturæ. It is therefore not to be translated as if it were synonymous with corpus; and in fact in a subsequent passage (II. § 50.) "res" and "corpus" are, so to speak, placed in opposition to each other. "Rerum formæ et Corporum schematismi."

calidæ in balneis videntur calefieri per accidens, sive per flammam aut ignem subterraneum, qualis ex Ætna et montibus aliis compluribus evomitur, sive ex conflictu corporum, quemadmodum calor fit in ferri et stanni dissolutionibus. Itaque gradus caloris in inanimatis, quatenus ad tactum humanum, nullus est; veruntamen illa gradu frigoris differunt; non enim æque frigidum est lignum ac metallum. Sed hoc pertinet ad *Tabulam Graduum in Frigido.*

2. Attamen quoad potentiales calores et præparationes ad flammam, complura inveniuntur inanimata admodum disposita, ut sulphur, naphtha, petrelæum.[1]

3. Quæ antea incaluerunt, ut fimus equinus ex animali, aut calx aut fortasse cinis aut fuligo ex igne, reliquias latentes quasdam caloris prioris retinent. Itaque fiunt quædam distillationes et separationes corporum per sepulturam in fimo equino, atque excitatur calor in calce per aspersionem aquæ; ut jam dictum est.

4. Inter vegetabilia non invenitur aliqua planta sive pars plantæ (veluti lachryma aut medulla) quæ sit ad tactum humanum calida. Sed tamen (ut superius dictum est) herbæ virides conclusæ calescunt; atque ad interiorem tactum, veluti ad palatum aut ad stomachum aut etiam ad exteriores partes, post aliquam moram (ut in emplastris et unguentis) alia vegetabilia inveniuntur calida, alia frigida.

5. Non invenitur in partibus animalium, postquam fuerint mortuæ aut separatæ, aliquid calidum ad tactum humanum. Nam neque fimus equinus ipse, nisi fuerit conclusus et sepultus, calorem retinet. Sed tamen omnis fimus habere videtur calorem potentialem,

[1] The Latin form of the word is *petroleum.*

ut in agrorum impinguatione. Et similiter, cadavera animalium hujusmodi habent latentem et potentialem calorem; adeo ut in cœmeteriis ubi quotidie fiunt sepulturæ terra calorem quendam occultum colligat, qui cadaver aliquod recenter impositum consumit longe citius quam terra pura. Atque apud orientales traditur inveniri textile quoddam tenue et molle, factum ex avium plumagine, quod vi innata butyrum solvat et liquefaciat in ipso leviter involutum.

6. Quæ impinguant agros, ut fimi omnis generis, creta, arena maris, sal, et similia, dispositionem nonnullam habent ad calidum.

7. Omnis putrefactio in se rudimenta quædam exilis caloris habet,[1] licet non hucusque ut ad tactum percipiatur. Nam nec ea ipsa quæ putrefacta solvuntur in animalcula, ut caro, caseus, ad tactum percipiuntur calida; neque lignum putre, quod noctu splendet, deprehenditur ad tactum calidum. Calor autem in putridis quandoque se prodit per odores tetros et fortes.

8. Primus itaque caloris gradus, ex iis quæ ad tactum humanum percipiuntur calida, videtur esse calor animalium, qui bene magnam habet graduum latitudinem. Nam infimus gradus (ut in insectis) vix ad tactum deprenditur; summus autem gradus vix attingit ad gradum caloris radiorum solis in regionibus et temporibus maxime ferventibus, neque ita acris est quin tolerari possit a manu. Et tamen referunt de Constantio,[2] aliisque nonnullis qui constitutionis et habitus corporis

[1] This is true of eremacausis rather than of real putrefaction. But the distinction belongs to the recent history of chemistry.

[2] The person here referred to is Constantius II., the son of Constantine the Great. The burning heat of the fever of which he died is mentioned by Ammianus Marcellinus, l. xxi. c. 15.

admodum sicci fuerunt, quod acutissimis febribus correpti ita incaluerint ut manum admotam aliquantulum urere visi sint.

9. Animalia, ex motu et exercitatione, ex vino et epulis, ex venere, ex febribus ardentibus, et ex dolore, augentur calore.

10. Animalia in accessibus febrium intermittentium a principio frigore et horrore corripiuntur, sed paulo post majorem in modum incalescunt; quod etiam faciunt a principio in causonibus et febribus pestilentialibus.

11. Inquiratur ulterius de calore comparato in diversis animalibus, veluti piscibus, quadrupedibus, serpentibus, avibus; atque etiam secundum species ipsorum, ut in leone, milvio, homine; nam ex vulgari opinione, pisces per interiora minus calidi sunt, aves autem maxime calidæ; præsertim columbæ, accipitres, struthiones.[1]

12. Inquiratur ulterius de calore comparato in eodem animali, secundum partes et membra ejus diversa. Nam lac, sanguis, sperma, ova, inveniuntur gradu modico tepida, et minus calida quam ipsa caro exterior in animali quando movetur aut agitatur. Qualis vero gradus sit caloris in cerebro, stomacho, corde, et reliquis, similiter adhuc non est quæsitum.

13. Animalia omnia, per hyemem et tempestates frigidas, secundum exterius frigent; sed per interiora etiam magis esse calida existimantur.

14. Calor cœlestium, etiam in regione calidissima atque temporibus anni et diei calidissimis, non eum gradum caloris obtinet qui vel lignum aridissimum vel

[1] Struthio commonly means an ostrich, but it seems here to be used for a sparrow. — *J. S.*

stramen vel etiam linteum ustum incendat aut adurat, nisi per specula comburentia roboretur; sed tamen e rebus humidis vaporem excitare potest.

15. Ex traditione astronomorum ponuntur stellæ aliæ magis, aliæ minus calidæ. Inter planetas enim post solem ponitur Mars calidissimus, deinde Jupiter, deinde Venus;[1] ponuntur autem tanquam frigidi Luna et deinde omnium maxime Saturnus. Inter fixas autem ponitur calidissimus Sirius, deinde Cor Leonis, sive Regulus, deinde Canicula, etc.

16. Sol magis calefacit, quo magis vergit ad perpendiculum sive Zenith, quod etiam credendum est de aliis planetis, pro modulo suo caloris; exempli gratia, Jovem magis apud nos calefacere cum positus sit sub Cancro aut Leone quam sub Capricorno aut Aquario.

17. Credendum est solem ipsum et planetas reliquos magis calefacere in perigæis suis, propter propinquitatem ad terram, quam in apogæis. Quod si eveniat ut in aliqua regione sol sit simul in perigæo et propius ad perpendiculum, necesse est ut magis calefaciat quam in regione ubi sol sit similiter in perigæo sed magis ad obliquum. Adeo ut comparatio exaltationis planetarum notari debeat, prout ex perpendiculo aut obliquitate participet, secundum regionum varietatem.

18. Sol etiam, et similiter reliqui planetæ, calefacere magis existimantur cum sint in proximo ad stellas fixas majores; veluti cum sol ponitur in Leone, magis vicinus fit Cordi Leonis, Caudæ Leonis, et Spicæ Virginis, et Sirio, et Caniculæ, quam cum ponitur in Cancro, ubi tamen magis sistitur ad perpendiculum.[2] Atque

[1] By some Venus was accounted cold and moist. Vide *Margarita Phil.* p. 627. Ptolemy, however, confirms what Bacon says of her.

[2] This astrological fancy was probably suggested by a wish to explain

credendum est partes cœli majorem infundere calorem (licet ad tactum minime perceptibilem) quo magis ornatæ sint stellis, præsertim majoribus.

19. Omnino calor cœlestium augetur tribus modis; videlicet ex perpendiculo, ex propinquitate sive perigæo, et ex conjunctione sive consortio stellarum.

20. Magnum omnino invenitur intervallum inter calorem animaliun ac etiam radiorum cœlestium (prout ad nos deferuntur), atque flammam, licet lenissimam, atque etiam ignita omnia, atque insuper liquores, aut aërem ipsum majorem in modum ab igne calefactum. Etenim flamma spiritus vini, præsertim rara nec constipata, tamen potis est stramen aut linteum aut papyrum incendere; quod nunquam faciet calor animalis vel solis, absque speculis comburentibus.

21. Flammæ autem et ignitorum plurimi sunt gradus in fortitudine et debilitate caloris. Verum de his nulla est facta diligens inquisitio; ut necesse sit ista leviter transmittere. Videtur autem ex flammis illa ex spiritu vini esse mollissima; nisi forte ignis fatuus, aut flammæ seu coruscationes ex sudoribus animalium, sint molliores. Hanc sequi opinamur flammam ex vegetabilibus levibus et porosis, ut stramine, scirpis, et foliis arefactis, a quibus non multum differre flammam ex pilis aut plumis. Hanc sequitur fortasse flamma ex lignis, præsertim iis quæ non multum habent ex resina aut pice; ita tamen ut flamma ex lignis quæ parva sunt mole (quæ vulgo colligantur in fasciculos) lenior sit quam quæ fit ex truncis arborum et radicibus. Id quod vulgo experiri licet in fornacibus quæ ferrum ex-

why July is hotter than June. In the division of the Zodiac into trigons each of which corresponds to one of the elements, Leo forms one of the corners of the fiery trigon; and it is moreover the sun's proper sign.

coquunt, in quibus ignis ex fasciculis et ramis arborum non est admodum utilis. Hanc sequitur (ut arbitramur) flamma ex oleo et sevo et cera, et hujusmodi oleosis et pinguibus, quæ sunt sine magna acrimonia. Fortissimus autem calor reperitur in pice et resina; atque adhuc magis in sulphure et caphura,[1] et naphtha et petrelæo et salibus (postquam materia cruda eruperit), et in horum compositionibus, veluti pulvere tormentario, igne Græco (quem vulgo ignem ferum vocant), et diversis ejus generibus, quæ tam obstinatum habent calorem ut ab aquis non facile extinguantur.

22. Existimamus etiam flammam quæ resultat ex nonnullis metallis imperfectis esse valde robustam et acrem. Verum de istis omnibus inquiratur ulterius.

23. Videtur autem flamma fulminum potentiorum has omnes flammas superare; adeo ut ferrum ipsum perfectum aliquando colliquaverit in guttas, quod flammæ illæ alteræ facere non possunt.

24. In ignitis autem diversi sunt etiam gradus caloris, de quibus etiam non facta est diligens inquisitio. Calorem maxime debilem existimamus esse ex linteo usto, quali ad flammæ excitationem uti solemus; et similiter ex ligno illo spongioso aut funiculis arefactis qui ad tormentorum accensionem adhibentur. Post hunc sequitur carbo ignitus ex lignis et anthracibus atque etiam ex lateribus ignitis, et similibus. Ignitorum autem vehementissime calida existimamus esse metalla ignita, ut ferrum et cuprum et cætera. Verum de his etiam facienda est ulterior inquisitio.

25. Inveniuntur ex ignitis nonnulla longe calidiora quam nonnullæ ex flammis. Multo enim calidius est

[1] Camphor.

et magis adurens ferrum ignitum quam flamma spiritus vini.

26. Inveniuntur etiam ex illis quæ ignita non sunt sed tantum ab igne calefacta, sicut aquæ ferventes et aër conclusus in reverberatoriis, nonnulla quæ superant calore multa ex flammis ipsis et ignitis.

27. Motus auget calorem; ut videre est in follibus et flatu; adeo ut duriora ex metallis non solvantur aut liquefiant per ignem mortuum aut quietum, nisi flatu excitetur.

28. Fiat experimentum per specula comburentia, in quibus (ut memini)[1] hoc fit, ut si speculum ponatur (exempli gratia) ad distantiam spithamæ ab objecto combustibili, non tantopere incendat aut adurat quam si positum fuerit speculum (exempli gratia) ad distantiam semi-spithamæ, et gradatim et lente trahatur ad distantiam spithamæ. Conus tamen et unio radiorum eadem sunt, sed ipse motus auget operationem caloris.[2]

29. Existimantur incendia illa quæ fiunt flante vento forti majores progressus facere adversus ventum quam secundum ventum; quia scilicet flamma resilit motu perniciore, vento remittente, quam procedit vento impellente.

30. Flamma non emicat aut generatur, nisi detur aliquid concavi in quo flamma movere possit et ludere; præterquam in flammis flatuosis pulveris tormentarii, et similibus, ubi compressio et incarceratio flammæ auget ejus furorem.

[1] Compare *De Calore et Frigore:* — "And the operation of them [burning-glasses] is, *as I remember*, first to place them," &c., which seems to prove, not only that Bacon had no burning-glass at hand, but also that he was not familiar with the use of them. — *J. S.*

[2] The only explanation of this is, that the focal length of the lens lay between a span and half a span.

31. Incus per malleum calefit admodum; adeo ut si incus fuerit laminæ tenuioris, existimemus illam per fortes et continuos ictus mallei posse rubescere, ut ferrum ignitum; sed de hoc fiat experimentum.

32. At in ignitis quæ sunt porosa, ita ut detur spatium ad exercendum motum ignis, si cohibeatur hujusmodi motus per compressionem fortem, statim extinguitur ignis; veluti cum linteum ustum aut filum ardens candelæ aut lampadis aut etiam carbo aut pruna ardens comprimitur per pressorium aut pedis conculcationem aut hujusmodi, statim cessant operationes ignis.

33. Approximatio ad corpus calidum auget calorem, pro gradu approximationis; quod etiam fit in lumine; nam quo propius collocatur objectum ad lumen eo magis est visibile.

34. Unio calorum diversorum auget calorem, nisi facta sit commistio corporum. Nam focus magnus et focus parvus in eodem loco nonnihil invicem augent calorem; at aqua tepida immissa in aquam ferventem refrigerat.

35. Mora corporis calidi auget calorem. Etenim calor perpetuo transiens et emanans commiscetur cum calore præinexistente, adeo ut multiplicet calorem. Nam focus non æque calefacit cubiculum per moram semihoræ ac si idem focus duret per horam integram. At hoc non facit lumen; etenim lampas aut candela in aliquo loco posita non magis illuminat per moram diuturnam quam statim ab initio.

36. Irritatio per frigidum ambiens auget calorem; ut in focis videre est per gelu acre. Quod existimamus fieri non tantum per conclusionem et contractionem caloris, quæ est species unionis, sed per exasperationem; veluti cum aër aut baculum violenter

comprimitur aut flectitur, non ad punctum loci prioris resilit, sed ulterius in contrarium. Itaque fiat diligens experimentum per baculum vel simile aliquid immissum in flammam, utrum ad latera flammæ non uratur citius quam in medio flammæ.

37. Gradus autem in susceptione caloris sunt complures. Atque primo omnium notandum est, quam parvus et exilis calor etiam ea corpora quæ caloris minime omnium sunt susceptiva immutet tamen et nonnihil calefaciat. Nam ipse calor manus globulum plumbi aut alicujus metalli paulisper detentum nonnihil calefacit. Adeo facile et in omnibus transmittitur et excitatur calor, corpore nullo modo ad apparentiam immutato.

38. Facillime omnium corporum apud nos et excipit et remittit calorem aër; quod optime cernitur in vitris calendaribus. Eorum confectio est talis:[1] accipiatur vitrum ventre concavo, collo tenui et oblongo; resupinetur et demittatur hujusmodi vitrum ore deorsum verso, ventre sursum, in aliud vasculum vitreum ubi sit aqua, tangendo fundum vasculi illius recipientis extremo ore vitri immissi, et incumbat paullulum vitri immissi collum ad os vitri recipientis, ita ut stare possit; quod ut commodius fiat, apponatur parum ceræ ad os vitri recipientis; ita tamen ut non penitus obturetur os ejus, ne ob defectum aëris succedentis impediatur motus de quo jam dicetur, qui est admodum facilis et delicatus.

Oportet autem ut vitrum demissum, antequam in-

[1] I am very much inclined to think that Bacon heard of the vitrum calendare from Fludde, or à Fluctibus, as he is called in Latin, who returned from Italy in [1605], and in whose philosophy, built upon certain abstract notions of rarefaction and condensation, perpetual reference is made to the air-thermometer, to which he gives the same name.

seratur in alterum, calefiat ad ignem a parte superiori, ventre scilicet. Postquam autem fuerit vitrum illud collocatum ut diximus, recipiet et contrahet se aër (qui dilatatus erat per calefactionem), post moram sufficientem pro extinctione illius ascititii caloris, ad talem extensionem sive dimensionem qualis erit aëris ambientis aut communis tunc temporis quando immittitur vitrum, atque attrahet aquam in sursum ad hujusmodi mensuram. Debet autem appendi charta angusta et oblonga, et gradibus (quot libuerit) interstincta. Videbis autem, prout tempestas diei incalescit aut frigescit, aërem se contrahere in angustius per frigidum et extendere se in latius per calidum; id quod conspicietur per aquam ascendentem quando contrahitur aër, et descendentem sive depressum quando dilatatur aër. Sensus autem aëris, quatenus ad calidum et frigidum, tam subtilis est et exquisitus ut facultatem tactus humani multum superet; adeo ut solis radius aliquis, aut calor anhelitus, multo magis calor manus, super vitri summitatem positus, statim deprimat aquam manifesto.[1] Attamen existimamus spiritum ani-

[1] In consequence of this description of the Vitrum Calendare, the invention of the Thermometer has been ascribed to Bacon; but without good reason. Fludd was the first to publish an account of the Thermometer; but Nelli says, and (admitting his authorities) truly, that Galileo's invention was anterior to any publication of Fludd's. Nelli speaks of a letter preserved in the library of his family "in copiâ," which Castelli addressed to Cesarina in 1638. Castelli says that, more than thirty-five years before, Galileo had shown him an experiment which he describes; namely, the rise of the water into an inverted tube with a bulb at one extremity, when the open end of the tube is put into a vessel of water, and goes on, "del quale effetto il medesimo Signor Galileo si era servito per fabbricare un Istromento da esaminare i gradi del caldo e del freddo." Thus far Castelli; but how long after the original experiment the instrument was made, does not appear from his statement. Nelli also refers to Viviani's Life of Galileo, wherein it is said that Galileo invented the Thermometer between 1593 and 1597. It has not, I think, been remarked that the rise of water

malium magis adhuc exquisitum sensum habere calidi et frigidi, nisi quod a mole corporea impediatur et hebetetur.

39. Post aërem, existimamus corpora esse maxime sensitiva caloris ea quæ a frigore recenter immutata sint et compressa, qualia sunt nix et glacies; ea enim leni aliquo tepore solvi incipiunt et colliquari. Post illa sequitur fortasse argentum vivum. Post illud sequuntur corpora pinguia, ut oleum, butyrum, et similia; deinde lignum; deinde aqua; postremo lapides et metalla, quæ non facile calefiunt, præsertim interius. Illa tamen calorem semel susceptum diutissime retinent; ita ut later aut lapis aut ferrum ignitum in pelvim aquæ frigidæ immissum et demersum, per quartam partem horæ (plus minus) retineat calorem, ita ut tangi non possit.

40. Quo minor est corporis moles, eo citius per corpus calidum approximatum incalescit; id quod demonstrat omnem calorem apud nos esse corpori tangibili quodammodo adversum.

41. Calidum, quatenus ad sensum et tactum humanum, res varia est et respectiva; adeo ut aqua tepida, si manus frigore occupetur, sentiatur esse calida; sin manus incaluerit, frigida.

under the circumstances of Galileo's original experiment had already been described in Porta's *Natural Magic;* though, as is usually the case with Porta, one cannot be sure whether he had ever actually seen it. "Possumus etiam solo calore aquam ascendere facere. Sit dolium supra turrim, vel ligneum, vel argillaceum aut æreum, quod melius erit, et canalem habeat in medio, qui descendat inferius usque ad aquam, et in eâ submersus sit, sed adglutinatus, ne respiret. Calefiat vas superius vel sole vel igne, nam aër, qui in alvo continetur, rarefit et foras prolabitur, unde aquam in bullas tumere videbimus, mox absentiâ solis ubi vas refrigescit, aër condensatur, et quum non sufficiat inclusus aër vacuum replere, accersitur aqua et ascendit supra." —*Porta's Magic*, book xix. chap. 4.

XIV.

Quam inopes simus historiæ quivis facile advertet, cum in tabulis superioribus, præterquam quod loco historiæ probatæ et instantiarum certarum nonnunquam traditiones et relationes inseramus (semper tamen adjecta dubiæ fidei et auctoritatis nota), sæpenumero etiam hisce verbis, *fiat experimentum*, vel *inquiratur ulterius*, uti cogamur.

XV.

Atque opus et officium harum trium tabularum, Comparentiam Instantiarum ad Intellectum vocare consuevimus. Facta autem Comparentia, in opere ponenda est ipsa Inductio. Invenienda est enim super Comparentiam omnium et singularum Instantiarum natura talis, quæ cum natura data perpetuo adsit, absit, atque crescat et decrescat; sitque (ut superius dictum est) limitatio naturæ magis communis.[1] Hoc si mens jam ab initio facere tentet affirmative (quod sibi permissa semper facere solet), occurrent phantasmata et opinabilia et notionalia male terminata et axiomata quotidie emendanda; nisi libeat (scholarum more) pugnare pro falsis. Ea tamen proculdubio erunt meliora aut praviora pro facultate et robore intellectus qui operatur. At omnino Deo (Formarum inditori et opifici) aut fortasse angelis et intelligentiis competit Formas per affirmationem immediate nosse, atque ab initio contemplationis.[2] Sed certe supra hominem

[1] That is, a particular case of a more general nature. The force of the last clause may be thus illustrated: If all bodies were more or less luminous accordingly as they were more or less hot, the luminous and the hot would be concomitantia, but neither would be the form of the other. [See General Preface, § 8. — *J. S.*]

[2] It was, I apprehend, the received doctrine, that whatever knowledge

est; cui tantum conceditur, procedere primo per Negativas, et postremo loco desinere in Affirmativas, post omnimodam exclusionem.

XVI.

Itaque naturæ facienda est prorsus solutio et separatio, non per ignem certe, sed per mentem, tanquam ignem divinum. Est itaque Inductionis veræ opus primum (quatenus ad inveniendas Formas) Rejectio sive Exclusiva naturarum singularum quæ non inveniuntur in aliqua instantia ubi natura data adest, aut inveniuntur in aliqua instantia ubi natura data abest, aut inveniuntur in aliqua instantia crescere cum natura data decrescat, aut decrescere cum natura data crescat. Tum vero post Rejectionem et Exclusivam debitis modis factam, secundo loco (tanquam in fundo) manebit (abeuntibus in fumum opinionibus volatilibus) Forma affirmativa, solida et vera et bene terminata. Atque hoc breve dictu est, sed per multas ambages ad hoc pervenitur. Nos autem nihil fortasse ex iis quæ ad hoc faciunt prætermittemus.

XVII.

Cavendum autem est et monendum quasi perpetuo, ne, cum tantæ partes Formis videantur a nobis tribui, trahantur ea quæ dicimus ad Formas eas quibus hominum contemplationes et cogitationes hactenus assueverunt.

the angelic nature is capable of it attains at once. Thus it is said, "Inferiores substantiæ intellectivæ, scilicet animæ humanæ, habent potentiam intellectivam non completam naturaliter, sed completur in iis successivè per hoc quod accipiunt species a rebus. Potentia vero intellectiva in substantiis spiritualibus superioribus, id est in angelis, completa est per species intelligibiles connaturales: in quantum habent species intelligibiles connaturales ad omnia intelligenda quæ naturaliter cognoscere possunt." — *S. Thomas, Summa Theol.* 1ma, q. 45. a 2.

Primo enim, de Formis copulatis, quæ sunt (ut diximus) naturarum simplicium conjugia ex cursu communi universi, ut leonis, aquilæ, rosæ, auri, et hujusmodi, impræsentiarum non loquimur.[1] Tempus enim erit de iis tractandi, cum ventum fuerit ad Latentes Processus et Latentes Schematismos, eorumque inventionem, prout reperiuntur in substantiis (quas vocant) seu naturis concretis.

Rursus vero, non intelligantur ea quæ dicimus (etiam quatenus ad naturas simplices) de Formis et ideis abstractis, aut in materia non determinatis aut male determinatis. Nos enim quum de Formis loquimur, nil aliud intelligimus quam leges illas et determinationes actus puri, quæ naturam aliquam simplicem ordinant et constituunt; ut calorem, lumen, pondus; in omnimoda materia et subjecto susceptibili. Itaque eadem res est Forma Calidi aut Forma Luminis, et Lex Calidi sive Lex Luminis; neque vero a rebus ipsis et parte operativa unquam nos abstrahimus aut recedimus. Quare cum dicimus (exempli gratia) in inquisitione Formæ Caloris, *rejice tenuitatem*, aut *tenuitas non est ex Forma Caloris*, idem est ac si dicamus *potest homo superinducere calorem in corpus densum;* aut contra, *potest homo auferre aut arcere calorem a corpore tenui.*

Quod si cuiquam videantur etiam Formæ nostræ habere nonnihil abstracti, quod misceant et conjungant heterogenea (videntur enim valde esse heterogenea

[1] Bacon's principle that the form of any substance may be conceived as a combination of the forms which correspond to each of its qualities is well illustrated by the phrase "formæ copulatæ." The "forma copulata" is the "lex ex quâ corpus individuum edit actus puros." Of this law each section or paragraphus is the "forma alicujus ex naturis simplicibus quæ in eo corpore conjunguntur." I have already remarked on Mr. Wood's rendering of the word "paragraphus" in § 2.

calor cœlestium et ignis; rubor fixus in rosa aut similibus, et apparens in iride aut radiis opalii aut adamantis; mors ex summersione, ex crematione, ex punctura gladii, ex apoplexia, ex atrophia; et tamen conveniunt ista in natura calidi, ruboris, mortis), is se habere intellectum norit consuetudine et integralitate rerum et opinionibus captum et detentum.[1] Certissimum enim est ista, utcunque heterogenea et aliena, coire in Formam sive Legem eam quæ ordinat calorem aut ruborem aut mortem; nec emancipari posse potentiam humanam et liberari a naturæ cursu communi, et expandi et exaltari ad efficientia nova et modos operandi novos, nisi per revelationem et inventionem hujusmodi Formarum; et tamen post istam unionem naturæ, quæ est res maxime principalis, de naturæ divisionibus et venis, tam ordinariis quam interioribus et verioribus, suo loco postea dicetur.

XVIII.

Jam vero proponendum est exemplum Exclusionis sive Rejectionis naturarum, quæ per Tabulas Comparentiæ reperiuntur non esse ex Forma Calidi; illud interim monendo, non solum sufficere singulas tabulas ad Rejectionem alicujus naturæ, sed etiam unam-

[1] The objection here anticipated has actually been made. It has been said that we cannot be sure that any quality always proceeds from the same cause. And in truth, though the axiom "like causes produce like effects," and vice versâ, seems to be inseparable from the idea of causation, yet the force of the objection remains. For the reference of sensible qualities to outward objects involves a subjective element. The same colour, as referred to a substance as the object in which it resides, is a different thing as it is a fixed colour, or prismatic, or epipolar, &c. They agree, it may be said, in the type of undulation; but viewed as properties of bodies, or with reference to operations on them, they are distinct. And if we could go further into the mechanism of sensation, we should probably recede further both from concrete bodies and from practice.

quamque ex instantiis singularibus in illis contentis. Manifestum enim est ex iis quæ dicta sunt, omnem instantiam contradictoriam destruere opinabile de Forma. Sed nihilominus quandoque, perspicuitatis causa et ut usus tabularum clarius demonstretur, Exclusivam duplicamus aut repetimus.

Exemplum *Exclusivæ*, sive *Rejectionis Naturarum* a Forma Calidi.

1. Per radios solis, *rejice* naturam elementarem.[1]

2. Per ignem communem, et maxime per ignes subterraneos (qui remotissimi sunt et plurimum intercluduntur a radiis cœlestibus), *rejice* naturam cœlestem.

3. Per calefactionem omnigenum corporum (hoc est, mineralium, vegetabilium, partium exteriorum animalium, aquæ, olei, aëris, et reliquorum) ex approximatione sola ad ignem aut aliud corpus calidum, *rejice* omnem varietatem sive subtiliorem texturam corporum.

4. Per ferrum et metalla ignita, quæ calefaciunt alia corpora nec tamen omnino pondere aut substantia minuuntur, *rejice* inditionem sive mixturam substantiæ alterius calidi.

5. Per aquam ferventem atque aërem, atque etiam per metalla et alia solida calefacta, sed non usque ad ignitionem sive ruborem, *rejice* lucem aut lumen.

6. Per radios lunæ et aliarum stellarum (excepto sole), *rejice* etiam lucem et lumen.

7. Per Comparativam ferri igniti et flammæ spiritus vini (ex quibus ferrum ignitum plus habet calidi et

[1] This refers to the antithesis, almost fundamental in Peripatetic physics, of the celestial and the elementary. Heat, since the sun's rays are hot, cannot depend on the elemental as contradistinguished from the celestial nature.

minus lucidi, flamma autem spiritus vini plus lucidi et minus calidi), *rejice* etiam lucem et lumen.

8. Per aurum et alia metalla ignita, quæ densissimi sunt corporis secundum totum, *rejice* tenuitatem.

9. Per aërem, qui invenitur ut plurimum frigidus et tamen manet tenuis, *rejice* etiam tenuitatem.

10. Per ferrum ignitum, quod non intumescit mole sed manet intra eandem dimensionem visibilem, *rejice* motum localem aut expansivum secundum totum.

11. Per dilatationem aëris in vitris calendariis et similibus, qui movetur localiter et expansive manifesto neque tamen colligit manifestum augmentum caloris, *rejice* etiam motum localem aut expansivum secundum totum.

12. Per facilem tepefactionem omnium corporum, absque aliqua destructione aut alteratione notabili, *rejice* naturam destructivam aut inditionem violentam alicujus naturæ novæ.

13. Per consensum et conformitatem operum similium quæ eduntur a calore et a frigore, *rejice* motum tam expansivum quam contractivum secundum totum.

14. Per accensionem caloris ex attritione corporum, *rejice* naturam principialem. Naturam principialem vocamus eam quæ positiva reperitur in natura, nec causatur a natura præcedente.[1]

[1] Bacon here anticipates not merely the essential character of the most recent theory of heat, but also the kind of evidence by which it has been established. The proof that caloric does not exist, — in other words that heat is not the manifestation of a peculiar substance diffused through nature, — rests mainly on experiments of friction.

Mr. Joule and Professor Thomson ascribe the discovery of this proof chiefly to Sir Humphrey Davy (see Beddoes's *Contributions to Physical and Medical Knowledge*, p. 14.): but though Davy's experiments guard against sources of error of which Bacon takes no notice, the merit of having per-

Sunt et aliæ naturæ: neque enim Tabulas conficimus perfectas, sed exempla tantum.

Omnes et singulæ naturæ prædictæ non sunt ex Forma Calidi. Atque ab omnibus naturis prædictis liberatur homo in operatione super Calidum.

XIX.

Atque in Exclusiva jacta sunt fundamenta Inductionis veræ; quæ tamen non perficitur donec sistatur in Affirmativa. Neque vero ipsa Exclusiva ullo modo perfecta est, neque adeo esse potest sub initiis. Est enim Exclusiva (ut plane liquet) rejectio naturarum simplicium; quod si non habeamus adhuc bonas et veras notiones naturarum simplicium, quomodo rectificari potest Exclusiva? At nonnullæ ex supradictis (veluti notio naturæ elementaris, notio naturæ cœlestis, notio tenuitatis) sunt notiones vagæ, nec bene terminatæ. Itaque nos, qui nec ignari sumus nec obliti quantum opus aggrediamur (viz. ut faciamus intellectum humanum rebus et naturæ parem), nullo modo acquiescimus in his quæ adhuc præcepimus; sed et rem in ulterius provehimus, et fortiora auxilia in usum intellectus machinamur et ministramus, quæ nunc subjungemus. Et certe in Interpretatione Naturæ animus omnino taliter est præparandus et formandus, ut et sustineat se in gradibus debitis certitudinis, et tamen cogitet (præsertim sub initiis) ea quæad sunt multum pendere ex iis quæ supersunt.

ceived the true significance of the production of heat by friction belongs of right to Bacon.

It is curious that in the essay in which he opposes the doctrine of caloric, Davy endeavours to introduce a new error of the same kind, and to show that light really is a natura principialis, a peculiar substance which in combination with oxygen properly so called constitutes oxygen gas, which he accordingly calls phosoxygen.

XX.

Attamen quia citius emergit veritas ex errore quam ex confusione, utile putamus ut fiat permissio intellectui, post tres tabulas Comparentiæ Primæ (quales posuimus) factas et pensitatas, accingendi se et tentandi opus Interpretationis Naturæ in affirmativa; tam ex instantiis tabularum, quam ex iis quæ alias occurrent. Quod genus tentamenti, *Permissionem Intellectus* sive *Interpretationem Inchoatam*, sive *Vindemiationem Primam* appellare consuevimus.

Vindemiatio Prima de Forma Calidi.

Animadvertendum autem est, Formam rei inesse (ut ex iis quæ dicta sunt plane liquet) instantiis universis et singulis in quibus res ipsa inest; aliter enim Forma non esset; itaque nulla plane dari potest instantia contradictoria. Attamen longe magis conspicua invenitur Forma et evidens in aliquibus instantiis quam in aliis; in iis videlicet, ubi minus cohibita est natura Formæ et impedita et redacta in ordinem per naturas alias. Hujusmodi autem instantias, *Elucescentias* vel *Instantias Ostensivas* appellare consuevimus. Pergendum itaque est ad Vindemiationem ipsam Primam de Forma Calidi.

Per universas et singulas instantias, natura cujus limitatio est Calor [1] videtur esse Motus. Hoc autem maxime ostenditur in flamma, quæ perpetuo movetur; et in liquoribus ferventibus aut bullientibus, qui etiam perpetuo moventur. Atque ostenditur etiam in incitatione sive incremento caloris facto per motum; ut in follibus, et ventis; de quo

[1] Of which heat is a particular case.

vide Instant. 29. Tab. 3. Atque similiter in aliis modis motus, de quibus vide Instant. 28. et 31. Tab. 3. Rursus ostenditur in extinctione ignis et caloris per omnem fortem compressionem, quæ frænat et cessare facit motum; de qua vide Instant. 30. et 32. Tab. 3. Ostenditur etiam in hoc, quod omne corpus destruitur aut saltem insigniter alteratur ab omni igne et calore forti ac vehementi; unde liquodo constat, fieri a calore tumultum et perturbationem et motum acrem in partibus internis corporis, qui sensim vergit ad dissolutionem.

Intelligatur hoc quod diximus de Motu (nempe, ut sit instar generis ad Calorem [1]), non quod calor generet motum, aut quod motus generet calorem (licet et hæc in aliquibus vera sint); sed quod ipsissimus Calor, sive *quid ipsum* Caloris, sit Motus et nihil aliud; limitatus tamen per differentias quas mox subjungemus, postquam nonnullas cautiones adjecerimus ad evitandum æquivocum.

Calidum ad sensum res respectiva est, et in ordine ad hominem non ad universum; et ponitur recte ut effectus Caloris tantum in spiritum animalem. Quin etiam in seipso res varia est, cum idem corpus (prout sensus prædisponitur) inducat perceptionem tam calidi quam frigidi; ut patet per Instant. 41. Tab. 3.

Neque vero communicatio Caloris, sive natura ejus transitiva per quam corpus admotum corpori calido incalescit, confundi debet cum Forma Calidi. Aliud enim est Calidum, aliud Calefactivum. Nam per motum attritionis inducitur calor absque aliquo calido præcedente, unde excluditur Calefactivum a Forma Calidi.

[1] i. e. that it is as the genus of which heat is a species.

Atque etiam ubi calidum efficitur per approximationem calidi, hoc ipsum non fit ex Forma Calidi; sed omnino pendet a natura altiore et magis communi; viz. ex natura assimilationis sive multiplicationis sui; de qua facienda est separatim inquisitio.

At notio ignis plebeia est, et nihil valet; composita enim est ex concursu qui fit calidi et lucidi in aliquo corpore; ut in flamma communi, et corporibus accensis usque ad ruborem.

Remoto itaque omni æquivoco, veniendum jam tandem est ad Differentias veras quæ limitant Motum, et constituunt eum in Formam Calidi.

Prima igitur Differentia ea est; quod Calor sit motus Expansivus, per quem corpus nititur ad dilatationem sui, et recipiendi se in majorem sphæram sive dimensionem quam prius occupaverat. Hæc autem Differentia maxime ostenditur in flamma; ubi fumus sive halitus pinguis manifesto dilatatur et aperit se in flammam.

Ostenditur etiam in omni liquore fervente, qui manifesto intumescit, insurgit, et emittit bullas; atque urget processum expandendi se, donec vertatur in corpus longe magis extensum et dilatatum quam sit ipse liquor; viz. in vaporem aut fumum aut aërem.

Ostenditur etiam in omni ligno et combustibili; ubi fit aliquando exudatio, at semper evaporatio.

Ostenditur etiam in colliquatione metallorum, quæ (cum sint corporis compactissimi) non facile intumescunt et se dilatant; sed tamen spiritus eorum, postquam fuerit in se dilatatus, et majorem adeo dilatationem concupierit, trudit plane et agit

partes crassiores in liquidum. Quod si etiam calor fortius intendatur, solvit et vertit multum ex iis in volatile.

Ostenditur etiam in ferro aut lapidibus; quæ licet non liquefiant aut fundantur, tamen emolliuntur. Quod etiam fit in baculis ligni; quæ calefacta paullulum in cineribus calidis fiunt flexibilia.

Optime autem cernitur iste motus ina ëre, qui per exiguum calorem se dilatat continuo et manifesto; ut per Instant. 38. Tab. 3.

Ostenditur etiam in natura contraria Frigidi. Frigus enim omne corpus contrahit et cogit in angustius; adeo ut per intensa frigora clavi excidant ex parietibus, æra dissiliant, vitrum etiam calefactum et subito positum in frigido dissiliat et frangatur. Similiter aër per levem infrigidationem recipit se in angustius; ut per Instant. 38. Tab. 3. Verum de his fusius dicetur in inquisitione de Frigido.

Neque mirum est si Calidum et Frigidum edant complures actiones communes (de quo vide Instant. 32. Tab. 2.), cum inveniantur duæ ex sequentibus Differentiis (de quibus mox dicemus) quæ competunt utrique naturæ; licet in hac Differentia (de qua nunc loquimur) actiones sint ex diametro oppositæ. Calidum enim dat motum expansivum et dilatantem, Frigidum autem dat motum contractivum et coëuntem.

Secunda Differentia est modificatio prioris; hæc videlicet, quod Calor sit motus expansivus sive versus circumferentiam; hac lege tamen, ut una feratur corpus sursum. Dubium enim non est

quin sint motus complures mixti. Exempli gratia, sagitta aut spiculum simul et progrediendo rotat, et rotando progreditur. Similiter et motus Caloris simul est et expansivus et latio in sursum.

Hæc vero Differentia ostenditur in forcipe, aut bacillo ferreo immisso in ignem; quia si immittatur perpendiculariter tenendo manum superius, cito manum adurit; sin ex latere aut inferius, omnino tardius.

Conspicua etiam est in distillationibus per descensorium; quibus utuntur homines ad flores delicatiores, quorum odores facile evanescunt. Nam hoc reperit industria, ut collocent ignem non subter sed supra, ut adurat minus. Neque enim flamma tantum vergit sursum, sed etiam omne calidum.[1]

Fiat autem experimentum hujus rei in contraria natura Frigidi: viz. utrum frigus non contrahat corpus descendendo deorsum, quemadmodum calidum dilatat corpus ascendendo sursum. Itaque adhibeantur duo bacilla ferrea, vel duo tubi vitrei, quoad cætera pares, et calefiant nonnihil; et ponatur spongia cum aqua frigida, vel nix, subter unam, et similiter super alteram. Existimamus enim celeriorem fore refrigerationem ad extremitates in eo bacillo ubi nix ponitur supra quam in eo ubi nix ponitur subter; contra ac fit in calido.

Tertia Differentia ea est; ut Calor sit motus, non expansivus uniformiter secundum totum, sed expansivus per particulas minores corporis; et simul cohibitus et repulsus et reverberatus, adeo

[1] This is an instance to show that heat does not descend so rapidly as it ascends through liquids, which is true.

ut induat motum alternativum et perpetuo trepidantem et tentantem et nitentem et ex repercussione irritatum; unde furor ille ignis et caloris ortum habet.

Ista vero Differentia ostenditur maxime in flamma et liquoribus bullientibus; quæ perpetuo trepidant, et in parvis portionibus tument, et rursus subsidunt.

Ostenditur etiam in iis corporibus quæ sunt tam duræ compagis ut calefacta aut ignita non intumescant aut dilatentur mole; ut ferrum ignitum, in quo calor est acerrimus.

Ostenditur etiam in hoc, quod per frigidissimas tempestates focus ardeat acerrime.

Ostenditur etiam in hoc, quod cum extenditur aër in vitro calendari absque impedimento aut repulsione, uniformiter scilicet et æqualiter, non percipiatur calor. Etiam in ventis conclusis, licet erumpant vi maxima, tamen non percipitur calor insignis; quia scilicet motus fit secundum totum, absque motu alternante in particulis. Atque ad hoc fiat experimentum, utrum flamma non urat acrius versus latera quam in medio flammæ.

Ostenditur etiam in hoc, quod omnis ustio transigatur per minutos poros corporis quod uritur; adeo ut ustio subruat et penetret et fodicet et stimulet, perinde ac si essent infinitæ cuspides acus. Itaque ex hoc illud etiam fit, quod omnes aquæ fortes (si proportionatæ sint ad corpus in quod agunt) edant opera ignis, ex natura sua corrodente et pungente.

Atque ista Differentia (de qua nunc dicimus) communis est cum natura frigidi; in quo cohibetur

motus contractivus per renitentiam expandendi; quemadmodum in calido cohibetur motus expansivus per renitentiam contrahendi.

Itaque sive partes corporis penetrent versus interius sive penetrent versus exterius, similis est ratio; licet impar admodum sit fortitudo; quia non habemus hic apud nos in superficie terræ aliquid quod sit impense frigidum. Vide Instant. 27. Tab. 9.[1]

Quarta Differentia est modificatio prioris: hæc scilicet, quod motus ille stimulationis aut penetrationis debeat esse nonnihil rapidus et minime lentus; atque fiat etiam per particulas, licet minutas; tamen non ad extremam subtilitatem, sed quasi majusculas.

Ostenditur hæc Differentia in comparatione operum quæ edit ignis cum iis quæ edit tempus sive ætas. Ætas enim sive tempus arefacit, consumit, subruit, et incinerat, non minus quam ignis; vel potius longe subtilius; sed quia motus ejusmodi est lentus admodum et per particulas valde exiles, non percipitur calor.

Ostenditur etiam in comparatione dissolutionum ferri et auri. Aurum enim dissolvitur absque calore excitato; ferrum autem cum vehementi excitatione caloris, licet simili fere intervallo quoad tempus. Quia scilicet in auro, ingressus aquæ separationis est clemens et subtiliter insinuans, et cessio partium auri facilis; at in ferro, ingressus est asper et cum conflictu, et partes ferri habent obstinationem majorem.

Ostenditur etiam aliquatenus in gangrænis non-

[1] So in the original. — *J. S.*

nullis et mortificationibus carnium; quæ non excitant magnum calorem aut dolorem, ob subtilitatem putrefactionis.

Atque hæc sit *Prima Vindemiatio*, sive *Interpretatio inchoata* de Forma Calidi, facta per *Permissionem Intellectus*.

Ex Vindemiatione autem ista Prima, Forma sive definitio vera Caloris (ejus qui est in ordine ad universum, non relativus tantummodo ad sensum) talis est, brevi verborum complexu: *Calor est motus expansivus, cohibitus, et nitens per partes minores.* Modificatur autem expansio; *ut expandendo in ambitum, nonnihil tamen inclinet versus superiora.* Modificatur autem et nixus ille per partes; *ut non sit omnino segnis, sed incitatus et cum impetu nonnullo.*[1]

[1] The Inquisitio de formâ calidi suggests these remarks: —

1st. A great part of it conduces in no way to the result. This may be said to be the natural consequence of the method of inquiry.

2nd. Heat (caloric) is confounded with the effects of chemical agencies, which are said "exequi opera caloris."

3rd. A greater source of confusion is the complete absence of any recognition of the principle that all bodies tend to acquire the temperature of those about them, and that the difference ad tactum which makes one body feel hotter or colder than another depends not on its being hotter or colder, but on the different degree of facility which they have in communicating their own respective temperature. In consequence of this, it had always been taught that one class of bodies were in their own nature cold, another hot, and so on. All liquids were cold. Experiments with a thermometer would have shown that they were not; but these Bacon did not try, — an instance among others how far he was from rejecting all he had been taught.

Of which remarks we may observe that, of the "Instantiæ convenientes," 13. is an instance of the third, while from 22. to the end exemplify the second; — of the "Instantiæ in proximo," 14—19. are to be referred to the third; from 27. to the end, to the second.

4th. Calidum and Frigidum seem to be considered distinct and not correlative qualities.

5th. The adoption of astrological fables about the hot and cold influence

Quod vero ad Operativam attinet, eadem res est. Nam designatio est talis; *Si in aliquo corpore naturali*

of the stars and planets [is to be remarked in the *Tabula Graduum*, 15. et seqq.]

Then comes the result, that the natura calidi is a motus expansivus This is seen [in air], "Optime cernitur in aëre qui per exiguum calorem se dilatat continuo et manifesto, ut per Inst. 38. Tab. 3.:" that is, by the instance of a vitrum calendare, or air-thermometer. And this is beyond question a good instance. But then in the "exemplum exclusivæ," § 11., we read "Per dilatationem aëris in vitris calendariis et similibus, qui movetur localiter et expansive manifesto, neque tamen colligit manifestum augmentum caloris, rejice etiam motum localem aut expansivum secundum totum." How is this passage to be reconciled with the preceding? For if the example of the vitrum calendare proves anything, it proves a motus expansivus secundum totum; and if, on account of our having no manifest evidence that the air waxes hot when it expands, the example does not prove this, why is it adduced? The source of this confusion I believe to be that, though Bacon saw reason to affirm expansion to be the essence of the hot, yet he was perplexed by examples of two kinds: (α) bodies which do not visibly expand when they are heated, e. g. red-hot iron; (β) bodies which expand without becoming heated, e. g. compressed air when relieved from pressure. For the first difficulty, it might have occurred to him that the hot iron does expand, though not enough to be perceived (except by accurate measurement) to do so; and if he had followed the indication thus given, he might have been the discoverer of a general and most important law. The difficulty which the second class of phenomena creates ought to have prevented Bacon from assigning expansion as the forma calidi, — as being that which must always make a body hot, and without which it could not become so. For it would be too liberal an interpretation to say that the expressions "motus cohibitus et refrænatus," whereby the idea of expansion is qualified, refer to a condition essential in the case of elastic fluids, — namely that the expansion in becoming heated is due to an increased elasticity, and not to any decrease of external pressure. Even had the modification required by this class of cases been introduced, there still remains that of liquids whose temperature is below that of maximum density, which is altogether intractable. Of this phenomenon, however, it would be unreasonable to expect Bacon to have known anything. But setting it aside, if it were affirmed that Bacon, after having had a glimpse of the truth suggested by some obvious phenomena, had then recourse, as he himself expresses it, to certain "differentiæ inanes" in order to save the phenomena, I think it would be hard to dispute the truth of this censure.

Nevertheless, of the matters contained in the investigation, there are several of considerable interest, though, as has been said, they are not connected with the final result.

The relation between heat and mechanical action has recently become

poteris excitare motum ad se dilatandum aut expandendum; eumque motum ita reprimere et in se vertere, ut dilatatio illa non procedat æqualiter, sed partim obtineat, partim retrudatur; proculdubio generabis Calidum: non habita ratione, sive corpus illud sit elementare (ut loquuntur) sive imbutum a cœlestibus;[1] sive luminosum sive opacum; sive tenue sive densum; sive localiter expansum sive intra claustra dimensionis primæ contentum; sive vergens ad dissolutionem sive manens in statu; sive animal, sive vegetabile, sive minerale, sive aqua, sive oleum, sive aër, aut aliqua alia substantia quæcunque susceptiva motus prædicti. Calidum autem ad sensum res eadem est; sed cum analogia, qualis competit sensui.[2] Nunc vero ad ulteriora auxilia procedendum est.

the subject of some very remarkable speculations, derived from the views suggested by S. Carnot in his *Reflections sur la Puissance Motrice du Feu.* Two views have been propounded. In one (that of S. Carnot himself), mechanical action is regarded as convertible with the transference from body to body of caloric. The other rejects the notion of caloric (the substance of heat) altogether. On this view mechanical action is convertible with the generation of heat; i. e. the raising of a given quantity of a given body from one given temperature to another. Both make use of the axiom "ex nihilo nihil;" and the conclusions thus obtained, especially in the second way of considering the subject, which I cannot doubt is the true one, are most remarkable, and the more interesting because they are, so to speak, the interpretation of a maxim whose truth is admitted à priori.

[1] That is, whether the body derive its properties from the primary qualities of the elements, or be imbued with specific or virtual qualities through the influence of the heavenly bodies. Thus St. Thomas says: "Sicut enim virtus calefaciendi et infrigidandi est in igne et aquâ consequens proprias eorum formas, et virtus, &c., actio intellectualis in homine consequens animam rationalem, ita omnes virtutes et actiones mediorum corporum transcendentes virtutes elementorum consequuntur eorum proprias formas, et reducuntur sicut in altiora principia in virtutes corporum cœlestium, et adhuc altius in substantias separatas." — *De occultis Operibus Naturæ.*

[2] The "analogia qualis competit sensui" is the "analogia hominis." This appears from the passages where the word occurs in the *Distributio Operis*, p. 218., and in § 40. of this book, near the end. Thus the meaning of the passage is that "calidum ad sensum" is the same as "calidum per se," only considered subjectively. The clause "sed cum analogiâ," &c.,

XXI.

Post Tabulas Comparentiæ Primæ et Rejectionem sive Exclusivam, nec non Vindemiationem Primam factam secundum eas, pergendum est ad reliqua auxilia intellectus circa Interpretationem Naturæ et Inductionem veram ac perfectam. In quibus proponendis, ubi opus erit tabulis, procedemus super Calidum et Frigidum; ubi autem opus erit tantum exemplis paucioribus, procedemus per alia omnia; ut nec confundatur inquisitio, et tamen doctrina versetur minus in angusto.

Dicemus itaque primo loco, de *Prærogativis Instantiarum*:[1] secundo, de *Adminiculis Inductionis*: tertio, de *Rectificatione Inductionis*: quarto, de *Variatione Inquisitionis pro Natura Subjecti*:[2] quinto, de *Prærogativis Naturarum* quatenus ad inquisitionem, sive de eo quod inquirendum est prius et posterius: sexto, de *Terminis Inquisitionis*, sive de synopsi omnium naturarum in universo: septimo, de *Deductione ad Praxin*, sive de eo quod est in ordine ad Hominem: octavo, de *Parascevis ad Inquisitionem*: postremo autem, de *Scala Ascensoria et Descensoria Axiomatum*.

XXII.

Inter Prærogativas Instantiarum, primo proponemus

may be rendered — "but with that kind of reference to man as the percipient which belongs to the nature of a perception."

[1] Concerning the doctrine of Prærogative Instances, see *General Preface*, p. 93. — *J. S.*

[2] Compare the passage near the end of the last aphorism of this book — "Nunc vero ad adminicula et rectificationes inductionis, et *deinceps ad concreta* et latentes processus, et latentes schematismos, et cætera quæ aphorismo xxi. ordine proposuimus, pergendum;" and see *General Preface* p. 77. — *J. S.*

Instantias Solitarias. Eæ autem sunt Solitariæ, quæ exhibent naturam de qua fit inquisitio in talibus subjectis quæ nil habent commune cum aliis subjectis, præter illam ipsam naturam; aut rursus quæ non exhibent naturam de qua fit inquisitio in talibus subjectis quæ sunt similia per omnia cum aliis subjectis, præterquam in illa ipsa natura. Manifestum enim est quod hujusmodi instantiæ tollant ambages, atque accelerent et roborent Exclusivam; adeo ut paucæ ex illis sint instar multarum.

Exempli gratia: si fiat inquisitio de natura Coloris, Instantiæ Solitariæ sunt prismata, gemmæ chrystallinæ, quæ reddunt colores non solum in se sed exterius supra parietem, item rores, etc. Istæ enim nil habent commune cum coloribus fixis in floribus, gemmis coloratis, metallis, lignis, etc., præter ipsum colorem. Unde facile colligitur, quod Color nil aliud sit quam modificatio imaginis lucis[1] immissæ et receptæ; in priore genere, per gradus diversos incidentiæ; in posteriore, per texturas et schematismos varios corporis. Istæ autem Instantiæ sunt Solitariæ quatenus ad similitudinem.

Rursus in eadem inquisitione, venæ distinctæ albi et nigri in marmoribus, et variegationes colorum in floribus ejusdem speciei, sunt Instantiæ Solitariæ. Album enim et nigrum marmoris, et maculæ albi et purpurei in floribus garyophylli,[2] conveniunt fere in

[1] Reference is made to Telesius's system of vision. "Lux donata est facultate sese effundendi multiplicandique et aërem propriâ specie afficiendi, itaque et oculos subeundi." . . . Again, "lux quæ res quibus insunt [colores] permeat. . . ab ipsarum intingitur coloribus, et eas transvecta oculos subit." — *De Rerum Nat.* vii. 31. See also other passages of the same book. Bacon uses "imago" as equivalent to "species," the word used in the preceding quotation.

[2] Caryophyllea was a flower much cultivated in Holland in the sixteenth

omnibus præter ipsum colorem. Unde facile colligitur, Colorem non multum rei habere cum naturis alicujus corporis intrinsecis, sed tantum situm esse in positura partium crassiori et quasi mechanica. Istæ autem Instantiæ sunt Solitariæ quatenus ad discrepantiam. Utrunque autem genus Instantias Solitarias appellare consuevimus ; aut Ferinas,[1] sumpto vocabulo ab astronomis.

XXIII.

Inter Prærogativas Instantiarum, ponemus secundo loco *Instantias Migrantes*. Eæ sunt, in quibus natura inquisita migrat ad generationem, cum prius non existeret; aut contra migrat ad corruptionem, cum prius existeret. Itaque in utraque antistrophe, instantiæ tales sunt semper geminæ; vel potius una instantia in motu sive transitu, producta ad periodum adversam. At hujusmodi instantiæ non solum accelerant et roborant Exclusivam, sed etiam compellunt Affirmativam sive Formam ipsam in angustum. Necesse est enim ut Forma rei sit quippiam quod per hujusmodi Migrationem indatur, aut contra per hujusmodi Migrationem tollatur et destruatur. Atque licet omnis exclusio promoveat Affirmativam, tamen hoc magis directe fit in subjecto eodem quam in diversis. Forma autem (ut ex omnibus quæ dicta sunt manifesto liquet) prodens

century; see Lemmius, *De Miraculis* (1581), p. 107. (The description seems more applicable to the tulip.) The flowers meant are pinks and carnations.

[1] I believe the word which Bacon here employs is at least very much less used than another of perhaps the same origin for which he has perhaps accidentally substituted it. "Feralis," we read in the *Lexicon Mathematicum* of Vitalis (1668), which appears to give a tolerably complete vocabulary of astrological words, "apud astronomos dicitur planeta, quando fuerit in loco ubi nullam cum reliquis familiaritatem habet: quod quidem maximum est detrimentum," &c.

se in uno ducit ad omnia. Quo autem simplicior fuerit Migratio, eo magis habenda est instantia in pretio. Præterea Instantiæ Migrantes magni sunt usus ad partem operativam; quia cum proponant Formam copulatam cum Efficiente aut Privante, perspicue designant praxin in aliquibus; unde facilis etiam est transitus ad proxima. Subest tamen in illis nonnihil periculi, quod indiget cautione; hoc videlicet, ne Formam nimis retrahant ad Efficientem, et intellectum perfundant vel saltem perstringant falsa opinione de Forma ex intuitu Efficientis. Efficiens vero semper ponitur nil aliud esse quam vehiculum sive deferens Formæ.[1] Verum huic rei, per Exclusivam legitime factam, facile adhibetur remedium.

Proponendum itaque est jam exemplum Instantiæ Migrantis. Sit natura inquisita Candor sive Albedo: Instantia Migrans ad generationem est vitrum integrum et vitrum pulverizatum. Similiter, aqua simplex et aqua agitata in spumam. Vitrum enim integrum et aqua simplex diaphana sunt, non alba; at vitrum pulverizatum et aqua in spuma, alba, non diaphana. Itaque quærendum quid acciderit ex ista Migratione vitro aut aquæ. Manifestum enim est Formam Albedinis deferri et invehi per istam contusionem vitri et agitationem aquæ. Nihil autem reperitur accessisse, præter comminutionem partium vitri et aquæ, et aëris insertionem. Neque vero parum profectum est ad inveniendam Formam Albedinis, quod corpora duo per se diaphana, sed secundum magis et minus, (aër scilicet et aqua, aut aër et vitrum,) simul posita per minu-

[1] The causa efficiens is the vehiculum formæ, inasmuch as it *carries the form* into the subject matter on which it acts; in other words it actuates the potential existence of the form in the subject matter. (Cf. *De Aug.* iii. 4.)

tas portiones exhibeant Albedinem, per refractionem inæqualem radiorum lucis.[1]

Verum hac in re proponendum est etiam exemplum periculi et cautionis, de quibus diximus. Nimirum facile hic occurret intellectui ab hujusmodi Efficientibus depravato quod ad Formam Albedinis aër semper requiratur, aut quod Albedo generetur tantum per corpora diaphana; quæ omnino falsa sunt, et per multas Exclusiones convicta. Quin potius apparebit (misso aëre et hujusmodi) corpora omnino æqualia (secundum portiones opticas) dare diaphanum; corpora vero inæqualia per texturam simplicem, dare album; corpora inæqualia secundum texturam compositam, sed ordinatam, dare reliquos colores, præter nigrum; corpora vero inæqualia per texturam compositam, sed omnino inordinatam et confusam, dare nigrum.[2] Itaque de Instantia Migrante ad generationem in natura inquisita Albedinis, propositum est jam exemplum. Instantia autem Migrans ad corruptionem in eadem natura Albedinis, est spuma dissoluta, aut nix dissoluta. Exuit enim albedinem et induit diaphanum aqua, postquam fit integrale sine aëre.

Neque vero illud ullo modo prætermittendum est, quod sub Instantiis Migrantibus comprehendi debeant non tantum illæ quæ migrant ad generationem et pri-

[1] Bacon would perhaps have given as another illustration of what he has here said the beautiful whiteness of frosted silver, if he had been aware that it is in reality silver foam. It appears that when silver is in a state of fusion a very large quantity of oxygen is condensed on and within its surface, the whole of which escapes at the moment of solidification. This explanation of the appearance of granulated silver is due, I believe, to Gay Lussac.

[2] Compare *Valerius Terminus*, ch. xi.: — "It is then to be understood that absolute equality produceth transparence, inequality in simple order or proportion produceth whiteness, inequality in compound or respective order or proportion produceth other colours, and absolute or orderless inequality produceth blackness." — *J. S.*

vationem, sed etiam illæ quæ migrant ad majorationem et minorationem; cum illæ etiam tendant ad inveniendam Formam, ut per definitionem Formæ superius factam et Tabulam Graduum manifesto liquet. Itaque papyrus, quæ sicca cum fuerit alba est, at madefacta (excluso aëre et recepta aqua) minus alba est et magis vergit ad diaphanum, similem habet rationem cum instantiis supradictis.

XXIV.

Inter Prærogativas Instantiarum, tertio loco ponemus *Instantias Ostensivas*, de quibus in Vindemiatione Prima de Calido mentionem fecimus; quas etiam *Elucescentias*, sive *Instantias Liberatas et Prædominantes*, appellare consuevimus. Eæ sunt, quæ ostendunt naturam inquisitam nudam et substantivam, atque etiam in exaltatione sua aut summo gradu potentiæ suæ; emancipatam scilicet, et liberatam ab impedimentis, vel saltem per fortitudinem suæ virtutis dominantem super ipsa, eaque supprimentem et coercentem. Cum enim omne corpus suscipiat multas naturarum Formas copulatas et in concreto, fit ut alia aliam retundat, deprimat, frangat, et liget; unde obscurantur Formæ singulæ. Inveniuntur autem subjecta nonnulla in quibus natura inquisita præ aliis est in suo vigore, vel per absentiam impedimenti vel per prædominantiam virtutis. Hujusmodi autem instantiæ sunt maxime ostensivæ Formæ. Verum et in his ipsis instantiis adhibenda est cautio, et cohibendus impetus intellectus. Quicquid enim ostentat Formam, eamque trudit, ut videatur occurrere intellectui, pro suspecto habendum est, et recurrendum ad Exclusivam severam et diligentem.

Exempli gratia; sit natura inquisita Calidum. Instantia Ostensiva motus expansionis, quæ (ut superius dictum est) portio est præcipua Formæ Calidi, est vitrum calendare aëris. Etenim flamma, licet manifesto exhibeat expansionem, tamen propter momentaneam extinctionem non ostendit progressum expansionis. Aqua autem fervens, propter facilem transitionem aquæ in vaporem et aërem, non tam bene ostendit expansionem aquæ in corpore suo. Rursus ferrum ignitum, et similia, tantum abest ut progressum ostendant, ut contra per retusionem et fractionem spiritus per partes compactas et crassas (quæ domant et frænant expansionem) ipsa expansio non sit omnino conspicua ad sensum. At vitrum calendare clare ostendit expansionem in aëre, et conspicuam et progredientem et durantem, neque transeuntem.

Rursus, exempli gratia; sit natura inquisita Pondus. Instantia Ostensiva ponderis, est argentum vivum. Omnia enim superat pondere magno intervallo, præter aurum; quod non multo gravius est.[1] At præstantior instantia est ad indicandam Formam Ponderis argentum vivum quam aurum; quia aurum solidum est et consistens, quod genus referri videtur ad densum; at argentum vivum liquidum est et turgens spiritu, et tamen multis partibus exuperat gravitate diamantem, et ea quæ putantur solidissima. Ex quo ostenditur Formam Gravis sive Ponderosi dominari simpliciter in copia materiæ, et non in arcta compage.

[1] This mistake occurs also in the *Historia Densi et Rari*. According to Bacon, the density of mercury is to that of gold as thirty-nine is to forty, nearly; the real ratio being as little more than as seven to ten. The way in which his experiments were made accounts for a large part of this error. See the preface to the *Historia Densi et Rari*.

XXV.

Inter Prærogativas Instantiarum ponemus quarto loco *Instantias Clandestinas*, quas etiam *Instantias Crepusculi* appellare consuevimus. Eæ sunt veluti oppositæ Instantiis Ostensivis. Exhibent enim naturam inquisitam in infima virtute, et tanquam in incunabulis et rudimentis suis; tentantem et tanquam primo experientem, sed sub contraria natura latentem et subactam. Sunt autem hujusmodi instantiæ magni omnino momenti ad inveniendas Formas; quia sicut Ostensivæ ducunt facile ad differentias, ita Clandestinæ ducunt optime ad genera; id est, ad naturas illas communes quarum naturæ inquisitæ nihil aliud sunt quam limitationes.

Exempli gratia; sit natura inquisita Consistens, sive se determinans; cujus contrarium est Liquidum, sive fluens. Instantiæ Clandestinæ sunt illæ quæ exhibent gradum nonnullum debilem et infimum Consistentis in fluido; veluti bulla aquæ, quæ est tanquam pellicula quædam consistens et determinata, facta ex corpore aquæ. Similiter stillicidia, quæ, si adfuerit aqua quæ succedat, producunt se in filum admodum tenue, ne discontinuetur aqua; at si non detur talis copia aquæ quæ succedere possit, cadit aqua in guttis rotundis, quæ est figura quæ optime aquam sustinet contra discontinuationem. At in ipso temporis articulo cum desinit filum aquæ et incipit descensus in guttis, resilit ipsa aqua sursum ad evitandam discontinuationem. Quin in metallis, quæ cum funduntur sunt liquida sed magis tenacia, recipiunt se sæpe guttæ liquefactæ sursum, atque ita hærent. Simile quoddam est instantia speculorum puerilium, quæ solent facere pueruli in scirpis ex saliva, ubi

cernitur etiam pellicula consistens aquæ. At multo melius se ostendit hoc ipsum in altero illo ludicro puerili, quando capiunt aquam, per saponem factam paulo tenaciorem, atque inflant eam per calamum cavum, atque inde formant aquam tanquam in castellum bullarum; quæ per interpositionem aëris inducit consistentiam eo usque ut se projici nonnihil patiatur absque discontinuatione.[1] Optime autem cernitur hoc in spuma et nive, quæ talem induunt consistentiam ut fere secari possint; cum tamen sint corpora formata ex aëre et aqua, quæ utraque sunt liquida. Quæ omnia non obscure innuunt Liquidum et Consistens esse notiones tantum plebeias, et ad sensum; inesse autem revera omnibus corporibus fugam et evitationem se discontinuandi; eam vero in corporibus homogeneis (qualia sunt liquida) esse debilem et infirmam, in corporibus vero quæ sunt composita ex heterogeneis, magis esse vividam et fortem; propterea quod admotio heterogenei constringit corpora, at subintratio homogenei solvit et relaxat.

Similiter, exempli gratia; sit natura inquisita Attractio, sive Coitio Corporum. Instantia circa Formam ejus Ostensiva maxime insignis est magnes. Contraria autem natura Attrahenti est non Attrahens, licet in substantia simili. Veluti ferrum, quod non attrahit ferrum, quemadmodum nec plumbum plumbum, nec lignum lignum, nec aquam aqua. Instantia autem Clandestina est magnes ferro armatus, vel potius ferrum in magnete armato. Nam ita fert natura, ut magnes armatus in distantia aliqua non trahat ferrum fortius quam magnes non armatus. Verum si admoveatur

[1] Far tougher bubbles than the ordinary kind may be blown in water in which silk cocoons have been steeped. Some curious experiments on this subject are mentioned in Porter on *Silk Manufactures* (Lardner's Cyclop.).

ferrum, ita ut tangat ferrum in magnete armato, tunc magnes armatus longe majus pondus ferri sustinet quam magnes simplex et inermis, propter similitudinem substantiæ ferri versus ferrum; quæ operatio erat omnino Clandestina et latens in ferro, antequam magnes accessisset.[1] Itaque manifestum est Formam Coitionis esse quippiam quod in magnete sit vividum et robustum, in ferro debile et latens. Itidem notatum est sagittas parvas ligneas absque cuspide ferrea, emissas ex sclopetis grandibus, altius penetrare in materiam ligneam (puta latera navium, aut similia), quam easdem sagittas ferro acuminatas, propter similitudinem substantiæ ligni ad lignum, licet hoc ante in ligno latuerit. Itidem, licet aër aërem aut aqua aquam manifesto non trahat in corporibus integris, tamen bulla approximata bullæ facilius dissolvit bullam quam si bulla illa altera abesset, ob appetitum Coitionis aquæ cum aqua et aëris cum aëre. Atque hujusmodi Instantiæ Clandestinæ (quæ sunt usus nobilissimi, ut dictum est) in portionibus corporum parvis et subtilibus maxime se dant conspiciendas. Quia massæ rerum majores sequuntur Formas magis catholicas et generales; ut suo loco dicetur.

XXVI.

Inter Prærogativas Instantiarum ponemus quinto loco *Instantias Constitutivas*, quas etiam *Manipulares* appellare consuevimus. Eæ sunt quæ constituunt unam speciem naturæ inquisitæ tanquam Formam Minorem. Cum enim Formæ legitimæ (quæ sunt semper con-

[1] This explanation of the effect of arming a magnet is wholly unsatisfactory. Before the *Novum Organum* was published, Galileo had shown that the armature acts by producing a more perfect contact. See the *Dialogi dei Sistemi massimi*, Giorn. 3a. p. 440. I quote from the new edition. Firenze 1842.

vertibiles cum naturis inquisitis) lateant in profundo nec facile inveniantur, postulat res et infirmitas humani intellectus ut Formæ particulares, quæ sunt congregativæ *Manipulorum* quorundam instantiarum (neutiquam vero omnium) in notionem aliquam communem, non negligantur, verum diligentius notentur. Quicquid enim unit naturam, licet modis imperfectis, ad inventionem Formarum viam sternit. Itaque instantiæ quæ ad hoc utiles sunt non sunt contemnendæ potestatis, sed habent nonnullam Prærogativam.

Verum in his diligens est adhibenda cautio, ne intellectus humanus, postquam complures ex istis Formis particularibus adinvenerit atque inde partitiones sive divisiones naturæ inquisitæ confecerit, in illis omnino acquiescat, atque ad inventionem legitimam Formæ Magnæ se non accingat, sed præsupponat naturam velut a radicibus esse multiplicem et divisam, atque ulteriorem naturæ unionem, tanquam rem supervacuæ subtilitatis et vergentem ad merum abstractum, fastidiat et rejiciat.

Exempli gratia; sit natura inquisita Memoria, sive Excitans et Adjuvans memoriam. Instantiæ Constitutivæ sunt, ordo sive distributio, quæ manifesto juvat memoriam; item Loci in memoria artificiali, qui aut possunt esse loci secundum proprium sensum, veluti janua, angulus, fenestra, et similia, aut possunt esse personæ familiares et notæ, aut possunt esse quidvis ad placitum (modo in ordine certo ponantur), veluti animalia, herbæ; etiam verba, literæ, characteres, personæ historicæ, et cætera; licet nonnulla ex his magis apta sint et commoda, alia minus. Hujusmodi autem Loci memoriam insiguiter juvant, eamque longe supra vires naturales exaltant. Item carmina facilius hærent et

discuntur memoriter quam prosa. Atque ex isto Manipulo trium instantiarum, videlicet ordinis, locorum artificialis memoriæ, et versuum, constituitur species una auxilii ad Memoriam. Species autem illa *Abscissio Infiniti* recte vocari possit. Cum enim quis aliquid reminisci aut revocare in memoriam nititur, si nullam prænotionem habeat aut perceptionem ejus quod quærit, quærit certe et molitur et hac illac discurrit, tanquam in infinito. Quod si certam aliquam prænotionem habeat, statim abscinditur infinitum, et fit discursus memoriæ magis in vicino. In tribus autem illis instantiis quæ superius dictæ sunt, prænotio perspicua est et certa. In prima videlicet, debet esse aliquid quod congruat cum ordine; in secunda debet esse imago quæ relationem aliquam habeat sive convenientiam ad illa loca certa; in tertia, debent esse verba quæ cadant in versum; atque ita abscinditur infinitum. Aliæ autem instantiæ dabunt hanc alteram speciem; ut quicquid deducat Intellectuale ad feriendum Sensum (quæ ratio etiam præcipue viget in artificiali memoria) juvet Memoriam. Aliæ instantiæ dabunt hanc alteram speciem; ut quæ faciunt impressionem in affectu forti, incutientia scilicet metum, admirationem, pudorem, delectationem, juvent Memoriam. Aliæ instantiæ dabunt hanc alteram speciem; ut quæ maxime imprimuntur a mente pura et minus præoccupata ante vel post, veluti quæ discuntur in pueritia aut quæ commentamur ante somnum, etiam primæ quæque rerum vices, magis hæreant in Memoria. Aliæ instantiæ dabunt hanc alteram speciem; ut multitudo circumstantiarum sive ansarum juvet Memoriam; veluti scriptio per partes non continuatas, lectio, sive recitatio voce alta. Aliæ denique instantiæ dabunt hanc alteram speciem; ut quæ expectantur et atten-

tionem excitant melius hæreant quam quæ prætervolant. Itaque si scriptum aliquod vicies perlegeris, non tam facile illud memoriter disces quam si illud legas decies, tentando interim illud recitare, et ubi deficit memoria inspiciendo librum. Ita ut sint veluti sex Formæ Minores eorum quæ juvant Memoriam; videlicet abscissio infiniti; deductio intellectualis ad sensibile; impressio in affectu forti; impressio in mente pura; multitudo ansarum; præexpectatio.

Similiter, exempli gratia; sit natura inquisita Gustus, sive Gustatio. Instantiæ quæ sequuntur sunt Constitutivæ: videlicet, quod qui non olfaciunt sed sensu eo a natura destituti sunt, non percipiant aut gustu distinguant cibum rancidum aut putridum, neque similiter alliatum aut rosatum, aut hujusmodi. Rursus, illi qui per accidens nares habent per descensum rheumatis obstructas, non discernunt aut percipiunt aliquid putridum aut rancidum aut aqua rosacea inspersum. Rursus, qui afficiuntur hujusmodi rheumate, si in ipso momento cum aliquid fœtidum aut odoratum habent in ore sive palato emungant fortiter, in ipso instanti manifestam perceptionem habent rancidi vel odorati. Quæ instantiæ dabunt et constituent hanc speciem, vel partem potius, gustus; ut sensus gustationis ex parte nihil aliud sit quam olfactus interior, transiens et descendens a narium meatibus superioribus in os et palatum. At contra, salsum et dulce et acre et acidum et austerum et amarum, et similia, hæc (inquam) omnia æque sentiunt illi in quibus olfactus deest aut obturatur, ac quisquam alius; ut manifestum sit sensum gustus esse compositum quiddam ex olfactu interiori et tactu quodam exquisito; de quo nunc non est dicendi locus.

Similiter, exempli gratia; sit natura inquisita Com-

municatio Qualitatis absque Commistione Substantiæ. Instantia Lucis dabit vel constituet unam speciem Communicationis; Calor vero et Magnes alteram. Communicatio enim lucis est tanquam momentanea, et statim perit, amota luce originali. At calidum et virtus magnetica, postquam tramissa fuerint vel potius excitata in alio corpore, hærent et manent ad tempus non parvum, amoto primo movente.

Denique magna est omnino Prærogativa Instantiarum Constitutivarum, ut quæ plurimum faciant et ad definitiones (præsertim particulares), et ad divisiones sive partitiones naturarum; de quo non male dixit Plato, *Quod habendus sit tanquam pro Deo, qui definire et dividere bene sciat.*[1]

XXVII.

Inter Prærogativas Instantiarum ponemus sexto loco *Instantias Conformes*, sive *Proportionatas;* quas etiam *Parallelas*, sive *Similitudines Physicas*, appellare consuevimus. Eæ vero sunt, quæ ostendunt similitudines et conjugationes rerum, non in Formis Minoribus (quod faciunt Instantiæ Constitutivæ) sed plane in concreto. Itaque sunt tanquam primi et infimi gradus ad unionem Naturæ. Neque constituunt aliquod axioma statim ab initio, sed indicant et observant tantum quendam consensum corporum. Atta-

[1] Bacon perhaps refers to the passage in the *Philebus*, in which the resolution of articulate sounds into their elements is referred to *εἴτε τις θεὸς εἴτε καὶ θεῖος ἄνθρωπος.* Compare Jamblichus (apud Stobæum, § 81.): *Θεὸς ἦν τις ὡς ἀληθῶς ὁ καταδείξας τὴν διαλεκτικὴν καὶ καταπέμψας τοῖς ἀνθρώποις.* [Mr. Kitchin, in his edition of the *Novum Organum* (Oxford, 1855), which I did not see till this was in type, refers to the *Phædrus*, 266. a.,—*τούτων δὴ ἔγωγε αὐτός τε ἐραστὴς τῶν διαιρέσεων καὶ συναγωνῶν . . . . ἐάν τε τινὰ ἄλλον κ. τ. λ. τοῦτον διώκω κατόπισθε μετ' ἴχνιον ὥστε θεοῖο,*—which is undoubtedly the passage alluded to.—*J. S.*]

men licet non multum promoveant ad inveniendas Formas, nihilominus magna cum utilitate revelant partium universi fabricam, et in membris ejus exercent veluti anatomiam quandam; atque proinde veluti manu-ducunt interdum ad axiomata sublimia et nobilia, præsertim illa quæ ad mundi configurationem pertinent, potius quam ad naturas et Formas simplices.

Exempli gratia; Instantiæ Conformes sunt quæ sequuntur: speculum, et oculus; et similiter fabrica auris, et loca reddentia echo. Ex qua conformitate, præter ipsam observationem similitudinis, quæ ad multa utilis est, proclive est insuper colligere et formare illud axioma; videlicet, organa sensuum et corpora quæ pariunt reflexiones ad sensus esse similis naturæ. Rursus ex hoc ipso admonitus intellectus non ægre insurgit ad axioma quoddam altius et nobilius. Hoc nimirum; nihil interesse inter consensus sive sympathias corporum sensu præditorum, et inanimatorum sine sensu, nisi quod in illis accedat spiritus animalis ad corpus ita dispositum, in his autem absit. Adeo ut quot sint consensus in corporibus inanimatis, tot possint esse sensus in animalibus, si essent perforationes in corpore animato ad discursum spiritus animalis in membrum rite dispositum, tanquam in organum idoneum. Et rursus, quot sint sensus in animalibus, tot sint proculdubio motus in corpore inanimato ubi spiritus animalis abfuerit; licet necesse sit multo plures esse motus in corporibus inanimatis quam sensus in animatis, propter paucitatem organorum sensus. Atque hujus rei ostendit se exemplum valde manifestum in doloribus. Etenim quum sint plura genera doloris in animalibus et tanquam varii illius characteres (veluti alius est dolor ustionis, alius

frigoris intensi, alius puncturæ, alius compressionis, alius extensionis, et similium), certissimum est omnia illa, quoad motum, inesse corporibus inanimatis; veluti ligno aut lapidi, cum uritur, aut per gelu constringitur, aut pungitur, aut scinditur, aut flectitur, aut tunditur, et sic de aliis; licet non subintrent sensus, propter absentiam spiritus animalis.

Item Instantiæ Conformes (quod mirum fortasse dictu) sunt radices et rami plantarum. Omne enim vegetabile intumescit, et extrudit partes in circumferentiam, tam sursum quam deorsum. Neque alia est differentia radicum et ramorum, quam quod radix includatur in terra, et rami exponantur aëri et soli.[1] Si quis enim accipiat ramum tenerum et vegetum arboris, atque illum reflectat in aliquam terræ particulam, licet non cohæreat ipsi solo, gignit statim non ramum, sed radicem. Atque vice versa, si terra ponatur superius, atque ita obstruatur lapide aut aliqua dura substantia ut planta cohibeatur nec possit frondescere sursum, edet ramos in aërem deorsum.

Item Instantiæ Conformes sunt gummi arborum, et pleræque gemmæ rupium. Utraque enim nil aliud sunt quam exudationes et percolationes succorum; in primo genere scilicet, succorum ex arboribus; in secundo, ex saxis; unde gignitur claritudo et splendor in utrisque, per percolationem nimirum tenuem et accuratam. Nam inde fit etiam, quod pili animalium non sint tam pulchri et tam vividi coloris quam avium

[1] In many plants part of the stem grows underground, while in others part at least of the root is above the surface. The true distinction has relation to the functions of the two organs. There is nothing in the root analogous (except under special circumstances) to buds or nodes, and consequently no true ramification.

plumæ complures; quia succi non tam delicate percolantur per cutem quam per calamum.

Item Instantiæ Conformes sunt scrotum in animalibus masculis, et matrix in femellis. Adeo ut nobilis illa fabrica per quam sexus differunt, (quatenus ad animalia terrestria) nil aliud videatur esse, quam secundum exterius et interius;[1] vi scilicet majore caloris genitalia in sexu masculo protrudente in exterius, ubi in femellis nimis debilis est calor quam ut hoc facere possit; unde accidit quod contineantur interius.

Item Instantiæ Conformes sunt pinnæ piscium, et pedes quadrupedum, aut pedes et alæ volucrum; quibus addidit Aristoteles quatuor volumina in motu serpentum.[2] Adeo ut in fabrica universi motus viventium plerumque videatur expediri per quaterniones artuum sive flexionum.

Item dentes in animalibus terrestribus, et rostra in avibus, sunt Instantiæ Conformes; unde manifestum est, in omnibus animalibus perfectis, fluere duram quandam substantiam versus os.

Item non absurda est Similitudo et Conformitis illa, ut homo sit tanquam planta inversa. Nam radix nervorum et facultatum animalium est caput; partes autem seminales sunt infimæ, non computatis extremitatibus tibiarum et brachiorum. At in planta, radix

[1] This remark seems to have been suggested by a similar passage in Telesius, *De Rerum Naturâ*, vi. 18.:—"Masculo . . . . magnus datus est calor, qui et membrum genitale foras propellat et sanguinem multum beneque omnem compactum conficiat, &c. Fœminæ autem . . . languens inditus est calor, qui neque genitale vas foras propellere nec è semine spiritum educere queat." The doctrine however of this passage was first taught by Galen, from whom Telesius derived it. See Galen, *De Usu Partium*, xiv. 6.

[2] De Anim. Incessu, i. 7.

(quæ instar capitis est) regulariter infimo loco collocatur; semina autem supremo.[1]

Denique illud omnino præcipiendum est et sæpius monendum; ut diligentia hominum in inquisitione et congerie Naturalis Historiæ deniceps mutetur plane, et vertatur in contrarium ejus quod nunc in usu est. Magna enim hucusque atque adeo curiosa fuit hominum industria in notanda rerum varietate atque explicandis accuartis animalium, herbarum, et fossilium differentiis; quarum pleræque magis sunt lusus naturæ quam seriæ alicujus utilitatis versus scientias. Faciunt certe hujusmodi res ad delectationem, atque etiam quandoque ad praxin; verum ad introspiciendam naturam parum aut nihil. Itaque convertenda plane est opera ad inquirendas et notandas rerum similitudines et analoga, tam in integralibus quam partibus. Illæ enim sunt quæ naturam uniunt, et constituere scientias incipiunt.[2]

Verum in his omnino est adhibenda cautio gravis et severa; ut accipiantur pro Instantiis Conformibus

[1] On the other hand, one is tempted to trace an analogy between the flower in plants and the skull in man and vertebrate animals in general: each occurring at the end of the axis of development, and each consisting of four segments — whorls or vertebræ. But by far the most remarkable analogy between plants and animals relates to the mode of development of their tissues, which, there is reason to believe, were all primarily formed from cells. The evidence in favour of this proposition is perhaps not yet quite complete.

It is curious that, after it had been established in the case of plants, Schleiden conceived that in this unity of original structure he had found a character peculiar to vegetable life, so that the analogy between plants and animals seemed to be impaired by the discovery.

[2] "Natura infinita est, sed qui symbola animadverterit omnia intelliget, licet non omnino," are the words of a great poet, who perhaps also is entitled to be called a great philosopher. They form the motto of one of the happiest illustrations of what Bacon meant by *instantia conformis*, — the Parthenogenesis of Professor Owen.

et Proportionatis, illæ quæ denotant Similitudines (ut ab initio diximus) Physicas; id est, reales et substantiales et immersas in natura, non fortuitas et ad speciem; multo minus superstitiosas aut curiosas, quales naturalis magiæ scriptores (homines levissimi, et in rebus tam seriis quales nunc agimus vix nominandi) ubique ostentant; magna cum vanitate et desipientia, inanes similitudines et sympathias rerum describentes atque etiam quandoque affingentes.

Verum his missis, etiam in ipsa configuratione mundi in majoribus non sunt negligendæ Instantiæ Conformes; veluti Africa, et regio Peruviana cum continente se porrigente usque ad Fretum Magellanicum. Utraque enim regio habet similes isthmos et similia promontoria, quod non temere accidit.[1]

Item Novus et Vetus Orbis; in eo quod utrique orbes versus septentriones lati sunt et exporrecti, versus austrum autem angusti et acuminati.

Item Instantiæ Conformes nobilissimæ sunt frigora intensa in media (quam vocant) aëris regione, et ignes acerrimi qui sæpe reperiuntur erumpentes ex locis subterraneis; quæ duæ res sunt ultimitates et extrema; naturæ scilicet Frigidi versus ambitum cœli, et naturæ Calidi versus viscera terræ; per antiperistasin, sive rejectionem naturæ contrariæ.

Postremo autem in axiomatibus scientiarum notatu digna est Conformitas Instantiarum. Veluti tropus rhetoricæ, qui dicitur Præter Expectatum, conformis

[1] A. von Humboldt has pointed out the conformity of the opposite shores of the Atlantic — the approximate correspondence between the projections on each side and the recesses on the other. But Bacon apparently compares not the opposite but the corresponding coasts of Africa and America. C. Concepcion would correspond to C. Negro; but the parallelism is not very close.

est tropo musicæ, qui vocatur Declinatio Cadentiæ. Si militer, postulatum mathematicum, ut *quæ eidem tertio æqualia sunt etiam inter se sint æqualia*, conforme est cum fabrica syllogismi in logica, qui unit ea quæ conveniunt in medio.[1] Denique multum utilis est in quamplurimis sagacitas quædam in conquirendis et indagandis Conformitatibus et Similitudinibus Physicis.

XXVIII.

Inter Prærogativas Instantiarum, ponemus septimo loco *Instantias Monodicas;*[2] quas etiam *Irregulares* sive *Heteroclitas* (sumpto vocabulo a grammaticis) appellare consuevimus. Eæ sunt, quæ ostendunt corpora in concreto, quæ videntur esse extravagantia et quasi abrupta in natura, et minime convenire cum aliis rebus ejusdem generis. Etenim Instantiæ Conformes sunt similes alterius, at Instantiæ Monodicæ sunt sui similes. Usus vero Instantiarum Monodicarum est talis qualis est Instantiarum Clandestinarum: viz. ad evehendam et uniendam naturam ad invenienda genera sive communes naturas, limitandas postea per differentias veras. Neque enim desistendum ab inquisitione donec proprietates et qualitates, quæ inveniuntur in hujusmodi rebus quæ possunt censeri pro miraculis naturæ, reducantur

[1] The importance of the parallel here suggested was never understood until the present time, because the language of mathematics and of logic has hitherto not been such as to permit the relation between them to be recognised. Mr. Boole's *Laws of Thought* contain the first development of ideas of which the germ is to be found in Bacon and Leibnitz; to the latter of whom the fundamental principle that in logic $a^2 = a$ was known (v. Leibnitz, *Philos. Works*, by Erdmann, 1840, p. 130). It is not too much to say that Mr. Boole's treatment of the subject is worthy of these great names.

Other calculuses of inference (using the word in its widest sense), besides the mathematical and the logical, yet perhaps remain to be developed; but this is a subject on which it is impossible here to enter.

[2] *Monadicas.* See note 3. p. 253. — *J. S.*

et comprehendantur sub aliqua Forma sive Lege certa ; ut irregularitas sive singularitas omnis reperiatur pendere ab aliqua Forma Communi ; miraculum vero illud sit tandem solummodo in differentiis accuratis et gradu et concursu raro, et non in ipsa specie ; ubi nunc contemplationes hominum non procedant ultra quam ut ponant hujusmodi res pro secretis et magnalibus naturæ, et tanquam incausabilibus, et pro exceptionibus regularum generalium.

Exempla Instantiarum Monodicarum sunt, sol et luna, inter astra ; magnes, inter lapides ; argentum vivum, inter metalla ; elephas, inter quadrupedes ; sensus veneris, inter genera tactus ; odor venaticus in canibus, inter genera olfactus. Etiam S litera apud grammaticos, habetur pro Monodica ; ob facilem compositionem quam sustinet cum consonantibus, aliquando duplicibus, aliquando triplicibus ; quod nulla alia litera facit. Plurimi autem faciendæ sunt hujusmodi instantiæ ; quia acuunt et vivificant inquisitionem, et medentur intellectui depravato a consuetudine et ab iis quæ fiunt plerunque.

XXIX.

Inter Prærogativas Instantiarum, ponemus loco octavo *Instantias Deviantes ;* errores scilicet naturæ, et vaga, ac monstra : ubi natura declinat et deflectit a cursu ordinario. Differunt enim Errores naturæ ab Instantiis Monodicis in hoc ; quod Monodicæ sint miracula specierum, at Errores sint miracula individuorum. Similis autem fere sunt usus ; quia rectificant intellectum adversus consueta, et revelant Formas Communes. Neque enim in his etiam desistendum ab inquisitione donec inveniatur causa hujusmodi declinationis. Veruntamen causa illa non exurgit ad

Formam aliquam proprie, sed tantum ad *latentem processum* ad Formam. Qui enim vias naturæ noverit, is deviationes etiam facilius observabit. At rursus, qui deviationes noverit, is accuratius vias describet.[1]

Atque in illo differunt etiam ab Instantiis Monodicis, quod multo magis instruant praxin et operativam. Nam novas species generare arduum admodum foret; at species notas variare, et inde rara multa ac inusitata producere, minus arduum. Facilis autem transitus est a miraculis naturæ ad miracula artis. Si enim deprehendatur semel natura in variatione sua, ejusque ratio manifesta fuerit, expeditum erit eo deducere naturam per artem quo per casum aberraverit. Neque solum eo, sed et aliorsum; cum errores ex una parte monstrent et aperiant viam ad errores et deflexiones undequaque. Hic vero exemplis non est opus, propter eorundem copiam. Facienda enim est congeries sive historia naturalis particularis omnium monstrorum et partuum naturæ prodigiosorum; omnis denique novitatis et raritatis et inconsueti in natura. Hoc vero faciendum est cum severissimo delectu, ut constet fides. Maxime autem habenda sunt pro suspectis quæ pendent quomodocunque a religione, ut prodigia Livii: nec minus, quæ inveniuntur in scriptoribus magiæ naturalis, aut etiam alchymiæ, et hujusmodi hominibus; qui tanquam proci sunt et amatores fabularum. Sed depromenda sunt illa ex gravi et fida historia, et auditionibus certis.

XXX.

Inter Prærogativas Instantiarum, ponemus loco nono *Instantias Limitaneas;* quas etiam *Participia* vocare consuevimus. Eæ vero sunt, quæ exhibent species

[1] See Owen, *On the Nature of Limbs*, p. 54.

corporum tales, quæ videntur esse compositæ ex speciebus duabus, vel Rudimenta inter speciem unam et alteram. Hæ vero Instántiæ inter Instantias Monodicas sive Heteroclitas recte numerari possunt: sunt enim in universitate rerum raræ et extraordinariæ. Sed tamen ob dignitatem seorsim tractandæ et ponendæ sunt; optime enim indicant compositionem et fabricam rerum, et innuunt causas numeri et qualitatis specierum ordinariarum in universo, et deducunt intellectum ab eo quod est, ad id quod esse potest.

Harum exempla sunt, muscus, inter putredinem et plantam; cometæ nonnulli, inter stellas et meteora ignita; pisces volantes, inter aves et pisces; vespertilliones, inter aves et quadrupedes; etiam

"Simia quam similis turpissima bestia nobis;" [1]

et partus animalium biformes et commisti ex speciebus diversis, et similia.

XXXI.

Inter Prærogativas Instantiarum ponemus decimo loco *Instantias Potestatis*, sive *Fascium* (sumpto vocabulo ab insignibus imperii), quas etiam *Ingenia*, sive *Manus Hominis* appellare consuevimus. Eæ sunt opera maxime nobilia et perfecta, et tanquam ultima in unaquaque arte. Cum enim hoc agatur præcipue ut natura pareat rebus et commodis humanis; consentaneum est prorsus, ut opera quæ jampridem in potestate hominis fuerunt (quasi provinciæ antea occupatæ et subactæ) notentur et numerentur; præsertim ea quæ sunt maxime enucleata et perfecta; propterea quod ab istis proclivior et magis in propinquo sit transitus ad nova et hactenus non inventa. Si quis enim ab horum contem-

[1] Ennius, quoted by Cicero.

platione attenta propositum acriter et strenue urgere velit, fiet certe ut aut producat illa paulo longius, aut deflectat illa ad aliquid quod finitimum est, aut etiam applicet et transferat illa ad usum aliquem nobiliorem.

Neque hic finis. Verum quemadmodum ab operibus naturæ raris et inconsuetis erigitur intellectus et elevatur ad inquirendas et inveniendas Formas quæ etiam illorum sunt capaces, ita etiam in operibus artis egregiis et admirandis hoc usu-venit; idque multo magis; quia modus efficiendi et operandi hujusmodi miracula artis manifestus ut plurimum est, cum plerunque in miraculis naturæ sit magis obscurus. Attamen in his ipsis cautio est adhibenda vel maxime, ne deprimant scilicet intellectum et eum quasi humo affigant.

Periculum enim est, ne per hujusmodi opera artis, quæ videntur velut summitates quædam et fastigia industriæ humanæ, reddatur intellectus attonitus et ligatus et quasi maleficiatus quoad illa, ita ut cum aliis consuescere non possit, sed cogitet nihil ejus generis fieri posse nisi eadem via qua illa effecta sunt, accedente tantummodo diligentia majore et præparatione magis accurata.

Contra illud ponendum est pro certo: vias et modos efficiendi res et opera quæ adhuc reperta sunt et notata, res esse plerunque pauperculas; atque omnem potentiam majorem pendere et ordine derivari a fontibus Formarum, quarum nulla adhuc inventa est.

Itaque (ut alibi diximus) [1] qui de machinis et arietibus, quales erant apud veteres, cogitasset, licet hoc fecisset obnixe atque ætatem in eo consumpsisset, nunquam tamen incidisset in inventum tormentorum igneorum operantium per pulverem pyrium. Neque rursus,

[1] I. § 109.

qui in lanificiis et serico vegetabili observationem suam et meditationem collocasset, unquam per ea reperisset naturam vermis aut serici bombycini.

Quocirca omnia inventa quæ censeri possunt magis nobilia (si animum advertas) in lucem prodiere nullo modo per pusillas enucleationes et extensiones artium, sed omnino per casum. Nihil autem repræsentat [1] aut anticipat casum (cujus mos est ut tantum per longa sæcula operetur) præter inventionem Formarum.

Exempla autem hujusmodi instantiarum particularia nihil opus est adducere, propter copiam eorundem. Nam hoc omnino agendum ; ut visitentur et penitus introspiciantur omnes artes mechanicæ, atque liberales etiam (quatenus ad opera), atque inde facienda est congeries sive historia particularis, tanquam magnalium et operum magistralium et maxime perfectorum in unaquaque ipsarum, una cum modis effectionis sive operationis.

Neque tamen astringimus diligentiam, quæ adhibenda est in hujusmodi collecta, ad ea quæ censentur pro magisteriis et arcanis alicujus artis tantum, atque movent admirationem. Admiratio enim proles est raritatis ; siquidem rara, licet in genere sint ex vulgatis naturis, tamen admirationem pariunt.

At contra, quæ revera admirationi esse debent propter discrepantiam quæ inest illis in specie collatis ad alias species, tamen si in usu familiari præsto sint leviter notantur. Debent autem notari Monodica artis, non minus quam Monodica naturæ ; de quibus antea diximus.[2] Atque quemadmodum in Monodicis naturæ posuimus solem, lunam, magnetem, et similia, quæ re vulgatissima sunt sed natura tamen fere singulari : idem et de Monodicis artis faciendum est.

[1] See note, p. 317. [2] II. § 28.

Exempli gratia ; Instantia Monodica artis est papyrus ; res admodum vulgata. At si diligenter animum advertas, materiæ artificiales aut plane textiles sunt per fila directa et transversa ; qualia sunt pannus sericus, aut laneus, et linteus, et hujusmodi ; aut coagmentantur ex succis concretis ; qualia sunt later, aut argilla figularis, aut vitrum, aut esmalta, aut porcellana, et similia ; quæ si bene uniantur splendent, sin minus, indurantur certe, sed non splendent. Attamen omnia talia, quæ fiunt ex succis concretis, sunt fragilia, nec ullo modo hærentia et tenacia. At contra, papyrus est corpus tenax, quod scindi et lacerari possit ; ita ut imitetur et fere æmuletur pellem sive membranam alicujus animalis, aut folium alicujus vegetabilis, et hujusmodi opificia naturæ. Nam neque fragilis est, ut vitrum ; neque textilis, ut pannus ; sed habet fibras certe, non fila distincta, omnino ad modum materiarum naturalium ; ut inter artificiales materias vix inveniatur simile aliquod, sed sit plane Monodicum.[1] Atque præferenda sane sunt in artificialibus ea quæ maxime accedunt ad imitationem naturæ, aut e contrario eam potenter regunt et invertunt.

Rursus, inter Ingenia et Manus Hominis, non prorsus contemnenda sunt præstigiæ et jocularia. Nonnulla enim ex istis, licet sint usu levia et ludicra, tamen informatione valida esse possunt.

Postremo, neque omnino omittenda sunt superstitiosa, et (prout vocabulum sensu vulgari accipitur) magica. Licet enim hujusmodi res sint in immensum obrutæ grandi mole mendaciorum et fabularum, tamen inspiciendum paulisper si forte subsit et lateat in aliquibus

[1] It is curious that Bacon should not have remarked that all the qualities here mentioned belong to felt as well as to paper.

earum aliqua operatio naturalis; ut in fascino, et fortificatione imaginationis, et consensu rerum ad distans, et transmissione impressionum a spiritu ad spiritum non minus quam a corpore ad corpus, et similibus.

XXXII.

Ex iis quæ ante dicta sunt, patet quod quinque illa instantiarum genera de quibus diximus (viz. Instantiarum Conformium, Instantiarum Monodicarum, Instantiarum Deviantium, Instantiarum Limitanearum, Instantiarum Potestatis) non debeant reservari donec inquiratur natura aliqua certa (quemadmodum instantiæ reliquæ, quas primo loco proposuimus, nec non plurimæ ex iis quæ sequentur, reservari debent); sed statim jam ab initio facienda est earum collectio, tanquam historia quædam particularis; eo quod digerant ea quæ ingrediuntur intellectum, et corrigant pravam complexionem intellectus ipsius, quem omnino necesse est imbui et infici et demum perverti ac distorqueri ab incursibus quotidianis et consuetis.

Itaque adhibendæ sunt eæ instantiæ tanquam præparativum aliquod, ad rectificandum et expurgandum intellectum. Quicquid enim abducit intellectum a consuetis æquat et complanat aream ejus ad recipiendum lumen siccum et purum notionum verarum.

Quin etiam hujusmodi instantiæ sternunt et præstruunt viam ad operativam; ut suo loco dicemus, quando de *Deductionibus ad Praxin* sermo erit.

XXXIII.

Inter Prærogativas Instantiarum ponemus loco undecimo *Instantias Comitatus*, atque *Hostiles;* quas etiam *Instantias Propositionum Fixarum* appellare consuevi-

mus. Eæ sunt instantiæ, quæ exhibent aliquod corpus sive concretum tale, in quo natura inquisita perpetuo sequatur tanquam comes quidam individuus; aut contra, in quo natura inquisita perpetuo fugiat atque ex comitatu excludatur, ut hostis et inimicus. Nam ex hujusmodi instantiis formantur propositiones certæ et universales, aut affirmativæ aut negativæ; in quibus subjectum erit tale corpus in concreto, prædicatum vero natura ipsa inquisita. Etenim propositiones particulares omnino *fixæ* non sunt, ubi scilicet natura inquisita reperitur in aliquo concreto fluxa et mobilis, viz. accedens sive acquisita, aut rursus recedens sive deposita. Quocirca particulares propositiones non habent Prærogativam aliquam majorem, nisi tantum in casu Migrationis, de quo antea dictum est. Et nihilominus, etiam particulares illæ propositiones comparatæ et collatæ cum universalibus multum juvant; ut suo loco dicetur. Neque tamen, etiam in universalibus istis propositionibus exactam aut absolutam affirmationem vel abnegationem requirimus. Sufficit enim ad id quod agitur etiamsi exceptionem nonnullam singularem aut raram patiantur.

Usus autem Instantiarum Comitatus est ad angustiandam Affirmativam Formæ. Quemadmodum enim in Instantiis Migrantibus angustiatur Affirmativa Formæ; viz. ut necessario poni debeat Forma rei esse aliquid quod per actum illum Migrationis inditur aut destruitur; ita etiam in Instantiis Comitatus angustiatur Affirmativa Formæ; ut necessario poni debeat Forma rei esse aliquid quod talem concretionem corporis subingrediatur, aut contra ab eadem abhorreat; ut qui bene norit constitutionem aut schematismum hujusmodi corporis non longe abfuerit ab extrahenda in lucem Forma naturæ inquisitæ.

Exempli gratia; sit natura inquisita Calidum. Instantia Comitatus est flamma. Etenim in aqua, aëre, lapide, metallo, et aliis quamplurimis, calor est mobilis, et accedere potest et recedere; at omnis flamma est calida, ita ut calor in concretione flammæ perpetuo sequatur. At Instantia Hostilis Calidi nulla reperitur apud nos. Nam de visceribus terræ nihil constat ad sensum; sed eorum corporum quæ nobis nota sunt nulla prorsus est concretio quæ non est susceptibilis caloris.

At rursus, sit natura inquisita Consistens. Instantia Hostilis est aër. Etenim metallum potest fluere, potest consistere; similiter vitrum; etiam aqua potest consistere, cum conglaciatur: at impossibile est ut aër unquam consistat, aut exuat fluorem.

Verum de instantiis hujusmodi Propositionum Fixarum supersunt duo monita, quæ utilia sunt ad id quod agitur. Primum, ut si defuerit plane universalis Affirmativa aut Negativa, illud ipsum diligenter notetur tanquam non-ens; sicut fecimus de Calido, ubi universalis Negativa (quatenus ad entia quæ ad nostram notitiam pervenerint) in rerum natura deest. Similiter, si natura inquisita sit Æternum aut Incorruptibile, deest Affirmativa universalis hic apud nos. Neque enim prædicari potest Æternum aut Incorruptibile de aliquo corpore eorum quæ infra cœlestia sunt, aut supra interiora terræ. Alterum monitum est, ut propositionibus universalibus, tam affirmativis quam negativis, de aliquo concreto, subjungantur simul ea concreta quæ proxime videntur accedere ad id quod est ex non-entibus; ut in calore, flammæ mollissimæ et minimum adurentes; in incorruptibili, aurum, quod proxime accedit. Omnia enim ista indicant terminos naturæ inter ens et non-ens; et faciunt ad circumscriptiones

Formarum, ne gliscant et vagentur extra conditiones materiæ.

XXXIV.

Inter Prærogativas Instantiarum, ponemus loco duodecimo ipsas illas *Instantias Subjunctivas*, de quibus in superiori aphorismo diximus; quas etiam *Instantias Ultimitatis* sive *Termini* appellare consuevimus. Neque enim hujusmodi instantiæ utiles sunt tantum, quatenus subjunguntur propositionibus fixis; verum etiam per se, et in proprietate sua. Indicant enim non obscure veras sectiones naturæ, et mensuras rerum, et illud *Quousque* natura quid faciat et ferat, et deinde transitus naturæ ad aliud. Talia sunt, aurum, in pondere; ferrum, in duritie; cete, in quantitate animalium; canis, in odore; inflammatio pulveris pyrii, in expansione celeri; et alia id genus. Nec minus exhibenda sunt ea quæ sunt ultima gradu infimo, quam quæ supremo; ut spiritus vini, in pondere;[1] sericum, in mollitie; vermiculi cutis, in quantitate animalium; et cætera.

XXXV.

Inter Prærogativas Instantiarum, ponemus loco decimo tertio *Instantias Fœderis* sive *Unionis*. Eæ sunt, quæ confundunt et adunant naturas quæ existimantur esse heterogeneæ, et pro talibus notantur et signantur per divisiones receptas.

At Instantiæ Fœderis ostendunt operationes et effectus quæ deputantur alicui ex illis heterogeneis ut propria, competere etiam aliis ex heterogeneis; ut convincatur ista heterogenia (quæ in opinione est) vera

[1] Although precise directions for making ether were given by Valerius Cordus in 1544, yet it is said to have remained unnoticed until it was rediscovered in the eighteenth century. Bacon's want of acquaintance with 't, implied in this and other passages, is therefore not surprising.

non esse aut essentialis, sed nil aliud esse quam modificatio naturæ communis. Optimi itaque sunt usus ad elevandum et evehendum intellectum a differentiis ad genera; et ad tollendum larvas et simulachra rerum, prout occurrunt et prodeunt personatæ in substantiis concretis.

Exempli gratia: sit natura inquisita Calidum. Omnino videtur esse divisio solennis et authentica quod sint tria genera caloris; viz. calor cœlestium, calor animalium, et calor ignis; quodque isti calores (præsertim unus ex illis comparatus ad reliquos duos) sint ipsa essentia et specie, sive natura specifica, differentes et plane heterogenei; quandoquidem calor cœlestium et animalium generet et foveat, at calor ignis contra corrumpat et destruat. Est itaque Instantia Fœderis experimentum illud satis vulgatum, cum recipitur ramus aliquis vitis intra domum ubi sit focus assiduus, ex quo maturescunt uvæ etiam mense integro citius quam foras; ita ut maturatio fructus etiam pendentis super arborem fieri possit scilicet ab igne, cum hoc ipsum videatur esse opus proprium solis.[1] Itaque ab

[1] The regular use of artificial heat in green-houses and conservatories was not known in Bacon's time. In the *Maison Champêtre*, an encyclopædia of gardening and agriculture published in 1607, nothing is said of it; nor is there anything on the subject in the writings of Porta, though in his *Nat. Mag.* he has spoken of various modes of accelerating the growth of fruits and flowers. In the *Sylva Sylvarum* (412.), however, Bacon speaks of housing hot-country plants to save them, and, in the *Essay on Gardens*, of stoving myrtles. The idea of what are now called green-houses was introduced into England from Holland about the time of the Revolution. The orangery at Heidelberg, formed, I believe, about the middle of the seventeenth century, is said to be the earliest conservatory on record.

It is related that Albertus Magnus, entertaining the emperor at Cologne during the winter, selected for the place of entertainment the garden of his monastery. Everything was covered with snow, and the guests were much inclined to be discontented; but when the feast began, the snow cleared away; the trees put forth, first leaves, then blossoms, then fruit; and the

hoc initio facile insurgit intellectus, repudiata heterogenia essentiali, ad inquirendum quæ sint differentiæ illæ quæ revera reperiuntur inter calorem solis et ignis, ex quibus fit ut eorum operationes sint tam dissimiles, utcunque illi ipsi participent ex natura communi.

Quæ differentiæ reperientur quatuor ; viz. primo quod calor solis respectu caloris ignis sit gradu longe clementior et lenior ; secundo, quod sit (præsertim ut defertur ad nos per aërem) qualitate multo humidior; tertio (quod caput rei est) quod sit summe inæqualis, atque accedens et auctus, et deinceps recedens et diminutus; id quod maxime confert ad generationem corporum. Recte enim asseruit Aristoteles [1] causam principalem generationum et corruptionum quæ fiunt hic apud nos in superficie terræ, esse viam obliquam solis per zodiacum ; unde calor solis, partim per vicissitudines diei et noctis, partim per successiones æstatis et hyemis, evadit miris modis inæqualis. Neque tamen desinit ille vir id quod ab eo recte inventum fuit statim corrumpere et depravare. Nam ut arbiter scilicet naturæ (quod illi in more est) valde magistraliter assignat causam generationis accessui solis, causam autem corruptionis recessui ; cum utraque res (accessus videlicet solis et recessus) non respective, sed quasi indifferenter, præbeat causam tam generationi quam corruptioni ; quandoquidem inæqualitas caloris generationi et corruptioni rerum, æqualitas conservationi tantum,

climate became that of summer. This glorious summer, which had thus abruptly succeeded to the winter of their discontent, lasted only till the conclusion of the feast, when everything resumed its former aspect. It would be a fanciful explanation, and I know not whether it has ever been suggested, to say that Albertus Magnus really entertained the emperor in a conservatory, and only led his guests through the garden. See, for the story, Grimm's *Deutsche Sagen*.

[1] Meteorologia, i. 14.

ministret. Est et quarta differentia inter calorem solis et ignis, magni prorsus momenti; viz. quod sol operationes suas insinuet per longa temporis spatia, ubi operationes ignis (urgente hominum impatientia) per breviora intervalla ad exitum perducantur. Quod si quis id sedulo agat, ut calorem ignis attemperet et reducat ad gradum moderatiorem et leniorem (quod multis modis facile fit), deinde etiam inspergat et admisceat nonnullam humiditatem, maxime autem si imitetur calorem solis in inæqualitate, postremo si moram patienter toleret (non certe eam quæ sit proportionata operibus solis, sed largiorem quam homines adhibere solent in operibus ignis), is facile missam faciet heterogeniam illam caloris, et vel tentabit vel exæquabit vel in aliquibus vincet opera solis, per calorem ignis. Similis Instantia Fœderis est resuscitatio papilionum ex frigore stupentium et tanquam emortuarum, per exiguum teporem ignis; ut facile cernas non magis negatum esse igni vivificare animantia quam maturare vegetabilia. Etiam inventum illud celebre Fracastorii de sartagine acriter calefacta, qua circundant medici capita apoplecticorum desperatorum,[1] expandit manifeste spiritus animales ab humoribus et obstructionibus cerebri compressos et quasi extinctos, illosque ad motum excitat, non aliter quam ignis operatur in aquam aut aërem, et tamen per consequens vivificat. Etiam ova aliquando excluduntur per calorem ignis, id quod prorsus imitatur calorem anima-

[1] It is mentioned in the life of Fracastorius, that when dying of apoplexy, and speechless, he made signs for the application of a cucurbita (or cupping-vessel) to his head, remembering the remarkable cure which he had effected in the case of a nun at Verona. It is scarcely necessary to remark that "dry cupping," as it is called, acts simply by partially removing the pressure of the atmosphere: the heat applied to the vessel has no other effect than that of rarefying the air it contains.

lem; et complura ejusmodi; ut nemo dubitare possit quin calor ignis in multis subjectis modificari possit ad imaginem caloris cœlestium et animalium.[1]

Similiter sint naturæ inquisitæ Motus et Quies. Videtur esse divisio solennis atque ex intima philosophia, quod corpora naturalia vel rotent, vel ferantur recta, vel stent sive quiescant. Aut enim est motus sine termino, aut statio in termino, aut latio ad terminum. At motus ille perennis rotationis videtur esse cœlestium proprius; statio sive quies videtur competere globo ipsi terræ; at corpora cætera (gravia quæ vocant et levia, extra loca scilicet connaturalitatis suæ sita) feruntur recta ad massas sive congregationes similium; levia sursum, versus ambitum cœli; gravia deorsum, versus terram. Atque ista pulchra dictu sunt.

At Instantia Fœderis est cometa aliquis humilior; qui cum sit longe infra cœlum, tamen rotat. Atque commentum Aristotelis[2] de alligatione sive sequacitate cometæ ad astrum aliquod jampridem explosum est; non tantum quia ratio ejus non est probabilis, sed propter experientiam manifestam discursus et irregularis motus cometarum per varia loca cœli.

At rursus alia Instantia Fœderis circa hoc subjectum est motus aëris; qui intra tropicos (ubi circuli rotationis sunt majores) videtur et ipse rotare ab oriente in occidentem.

Et alia rursus instantia foret fluxus et refluxus maris, si modo aquæ ipsæ deprehendantur ferri motu rotationis (licet tardo et evanido) ab oriente in occiden-

[1] Bacon's rejection of the essential heterogeneity of the three species of heat is apparently taken from Telesius, *De Rerum Nat.* vi. 20. Telesius remarks, as Bacon does, that eggs may be hatched, and insects apparently dead restored to life, by means of artificial heat.

[2] Meteorol. i. 4.

tem ; ita tamen ut bis in die repercutiantur. Itaque, si hæc ita se habeant, manifestum est motum istum rotationis non terminari in cœlestibus, sed communicari aëri et aquæ.

Etiam ista proprietas levium, nimirum ut ferantur sursum, vacillat nonnihil. Atque in hoc sumi potest pro Instantia Fœderis bulla aquæ. Si enim aër fuerit subter aquam, ascendit rapide versus superficiem aquæ, per motum illum plagæ (quam vocat Democritus) per quam aqua descendens percutit et attollit aërem sursum ; non autem per contentionem aut nixum aëris ipsius. Atqui ubi ad superficiem ipsam aquæ ventum fuerit, tum cohibetur aër ab ulteriore ascensu, per levem resistentiam quam reperit in aqua, non statim tolerante se discontinuari : ita ut exilis admodum sit appetitus aëris ad superiora.

Similiter sit natura inquisita Pondus. Est plane divisio recepta, ut densa et solida ferantur versus centrum terræ, rara autem et tenuia versus ambitum cœli ; tanquam ad loca sua propria. Atque loca quod attinet, (licet in scholis hujusmodi res valeant) plane inepta et puerilis cogitatio est, locum aliquid posse. Itaque nugantur philosophi cum dicant quod, si perforata esset terra, corpora gravia se sisterent quando ventum esset ad centrum. Esset enim certe virtuosum plane et efficax genus nihili, aut puncti mathematici, quod aut alia afficeret, aut rursus quod alia appeterent : corpus enim non nisi a corpore patitur. Verum iste appetitus ascendendi et descendendi aut est in schematismo corporis quod movetur, aut in sympathia sive consensu cum alio corpore. Quod si inveniatur aliquod corpus densum et solidum, quod nihilominus non feratur ad terram, confunditur hujus-

modi divisio. At si recipiatur opinio Gilberti, quod magnetica vis terræ ad alliciendum gravia non extendatur ultra orbem virtutis suæ (quæ operatur semper ad distantiam certam, et non ultra),[1] hocque per aliquam Instantiam verificetur, ea demum erit Instantia Fœderis circa hoc subjectum. Neque tamen occurrit impræsentiarum aliqua instantia super hoc certa et manifesta. Proxime videntur accedere cataractæ cœli, quæ in navigationibus per Oceanum Atlanticum versus Indias utrasque sæpe conspiciuntur. Tanta enim videtur esse vis et moles aquarum quæ per hujusmodi cataractas subito effunditur, ut videatur collectio aquarum fuisse ante facta, atque in his locis hæsisse et mansisse; et postea potius per causam violentam dejecta et detrusa esse, quam naturali motu gravitatis cecidisse; adeo ut conjici possit, corpoream molem densam atque compactam in magna distantia a terra fore pensilem tanquam terram ipsam, nec casuram nisi dejiciatur. Verum de hoc nil certi affirmamus. Interim in hoc et in multis aliis facile apparebit, quam inopes simus

[1] In Gilbert's philosophy, the earth's magnetic action is not distinguished from gravity. Thus he says: "Partes vero primariorum globorum integris alligatæ sunt, in illos naturali desiderio incumbunt. . . . . Non autem est appetitus aut inclinatio ad locum, aut spatium, aut terminum; sed ad corpus, ad fontem, ad matrem, ad principium ubi uniuntur, conservantur, et a periculis vagæ partes revocatæ quiescunt omnes. Ita tellus alliicit magnetica omnia, tum alia omnia in quibus vis magnetica primaria desiit materiæ ratione; quæ inclinatio in terrenis gravitas dicitur." — *De Mundo*, ii. c. 3. Again, that the magnetic action of the earth or of a magnet is confined to a definite orb appears from a variety of passages. See *De Magnete*, ii. c. 7., and the definitions prefixed to this work. Gilbert distinguished between the "orb of virtue," which includes the whole space through which any magnetic action extends, and the "orb of coition," which is "totum illud spatium per quod minimum magneticum per magnetem movetur." He asserts that the orb of the magnetic virtue extends to the moon, and ascribes the moon's inequalities to the effects it produces (*De Mundo*, ii. c. 19.). In the preceding chapter he remarks, "Luna magnetice alligatur terræ, quia facies ejus semper versus terram."

historiæ naturalis; cum loco instantiarum certarum nonnunquam suppositiones afferre pro exemplis cogamur.

Similiter sit natura inquisita Discursus Ingenii. Videtur omnino divisio vera, rationis humanæ et solertiæ brutorum. Attamen sunt nonnullæ instantiæ actionum quæ eduntur a brutis, per quas videntur etiam bruta quasi syllogizare; ut memoriæ proditum est de corvo, qui per magnas siccitates fere enectus siti conspexit aquam in trunco cavo arboris; atque cum non daretur ei intrare propter angustias, non cessavit jacere multos lapillos, per quos surgeret et ascenderet aqua ut bibere posset; quod postea cessit in proverbium.

Similiter sit natura inquisita Visibile. Videtur omnino esse divisio vera et certa, lucis, quæ est visibile originale et primam copiam facit visui, et coloris, qui est visibile secundarium et sine luce non cernitur, ita ut videatur nil aliud esse quam imago aut modificatio lucis.[1] Attamen ex utraque parte circa hoc videntur esse Instantiæ Fœderis; scilicet, nix in magna quantitate, et flamma sulphuris; in quarum altera videtur esse color primulum lucens, in altera lux vergens ad colorem.

XXXVI.

Inter Prærogativas Instantiarum, ponemus loco decimo quarto *Instantias Crucis;* translato vocabulo a Crucibus, quæ erectæ in biviis indicant et signant viarum separationes. Has etiam *Instantias Decisorias* et *Judiciales*, et in casibus nonnullis *Instantias Oraculi* et *Mandati*, appellare consuevimus. Earum ratio talis

[1] The doctrine of this passage seems to be taken from Telesius, *De Rerum Naturâ*, vii. c. 31.:—"Sensus ipse primo illam [lucem] et per se visilem colores siquidem visiles, at secundo a luce loco et lucis omnino opera visiles declarat."

est. Cum in inquisitione naturæ alicujus intellectus ponitur tanquam in æquilibrio, ut incertus sit utri naturarum e duabus, vel quandoque pluribus, causa naturæ inquisitæ attribui aut assignari debeat, propter complurium naturarum concursum frequentem et ordinarium, Instantiæ Crucis ostendunt consortium unius ex naturis (quoad naturam inquisitam) fidum et indissolubile, alterius autem varium et separabile; unde terminatur quæstio, et recipitur natura illa prior pro causa, missa altera et repudiata. Itaque hujusmodi instantiæ sunt maximæ lucis, et quasi magnæ auctoritatis; ita ut curriculum interpretationis quandoque in illas desinat, et per illas perficiatur. Interdum autem Instantiæ Crucis illæ occurrunt et inveniuntur inter jampridem notatas; at ut plurimum novæ sunt, et de industria atque ex composito quæsitæ et applicatæ, et diligentia sedula et acri tandem erutæ.[1]

Exempli gratia; sit natura inquisita Fluxus et Refluxus Maris, ille bis repetitus in die atque sexhorarius in accessibus et recessibus singulis, cum differentia nonnulla quæ coincidit in motum lunæ. Bivium circa hanc naturam tale est.

Necesse prorsus est ut iste motus efficiatur, vel ab aquarum progressu et regressu, in modum aquæ in pelvi agitatæ, quæ quando latus unum pelvis alluit deserit alterum; vel a sublatione et subsidentia aquarum e profundo, in modum aquæ ebullientis et rursus subsidentis. Utri vero causæ fluxus et refluxus ille assignari debeat, oritur dubitatio. Quod si recipiatur prior assertio, necesse est ut cum sit fluxus in mari ex una

[1] These are instances of the experiments spoken of in the *Distributio Operis*, "quæ ad intentionem ejus quod quæritur peritè et secundum artem excogitata et apposita sunt." (p. 218.)—*J. S.*

parte fiat sub idem tempus alicubi in mari refluxus ex alia. Itaque ad hoc reducitur inquisitio. Atqui observavit Acosta, cum aliis nonnullis (diligenti facta inquisitione), quod ad litora Floridæ et ad litora adversa Hispaniæ et Africæ, fiant fluxus maris ad eadem tempora, et refluxus itidem ad eadem tempora; non contra, quod cum fluxus fit ad littora Floridæ, fiat refluxus ad littora Hispaniæ et Africæ.[1] Attamen adhuc diligentius attendenti, non per hoc evincitur motus attollens, et abnegatur motus in progressu. Fieri enim potest, quod sit motus aquarum in progressu, et nihilominus inundet adversa littora ejusdem alvei simul; si aquæ scilicet illæ contrudantur et compellantur aliunde, quemadmodum fit in fluviis, qui fluunt et refluunt ad utrumque littus horis iisdem, cum tamen iste motus liquido sit motus in progressu, nempe aquarum ingredientium ostia fluminum ex mari. Itaque simili modo fieri potest, ut aquæ venientes magna mole ab Oceano Orientali Indico compellantur et trudantur in alveum Maris Atlantici, et propterea inundent utrumque latus simul. Quærendum itaque est, an sit alius alveus per quem aquæ possint iisdem temporibus minui et refluere. Atque præsto est Mare Australe, Mari Atlantico neutiquam minus, sed potius magis latum et extensum, quod ad hoc sufficere possit.

Itaque jam tandem perventum est ad Instantiam Crucis circa hoc subjectum. Ea talis est: si pro certo inveniatur, quod cum fit fluxus ad littora adversa tam Floridæ quam Hispaniæ in Mari Atlantico, fiat simul

[1] Compare the *De Fluxu et Refluxu Maris.* I have not been able to find this statement in Acosta, who speaks of the synchronism of the tides on the opposite sides of South America, as shown by the meeting of the tidal waves in the Straits of Magellan. (iii. 14.)

fluxus ad littora Peruviæ et juxta dorsum Chinæ in Mari Australi; tum certe per hanc Instantiam Decisoriam abjudicanda est assertio quod fluxus et refluxus maris, de quo inquiritur, fiat per motum progressivum: neque enim relinquitur aliud mare aut locus, ubi possit ad eadem tempora fieri regressus aut refluxus. Commodissime autem hoc sciri possit, si inquiratur ab incolis Panamæ et Limæ (ubi uterque Oceanus, Atlanticus et Australis, per parvum Isthmum separantur), utrum ad contrarias Isthmi partes fiat simul fluxus et refluxus maris, an e contra. Verum hæc decisio sive abjudicatio certa videtur, posito quod terra stet immobilis. Quod si terra rotet, fieri fortasse potest ut ex inæquali rotatione (quatenus ad celeritatem sive incitationem) terræ et aquarum maris, sequatur compulsio violenta aquarum in cumulum sursum, quæ sit fluxus; et relaxatio earundem (postquam amplius cumulari non sustinuerint) in deorsum, quæ sit refluxus. Verum de hoc facienda est inquisitio separatim. Attamen etiam hoc supposito illud æque manet fixum, quod necesse sit fieri alicubi refluxum maris ad eadem tempora quibus fiunt fluxus in aliis partibus.

Similiter, sit natura inquisita posterior ille motus ex duobus quos supposuimus, videlicet motus maris se attollens et rursus subsidens; si forte ita acciderit ut (diligenti facto examine) rejiciatur motus alter, de quo diximus, progressivus. Tum vero erit trivium circa hanc naturam tale. Necesse est ut motus iste, per quem aquæ in fluxibus et refluxibus se attollunt et rursus relabuntur, absque aliqua accessione aquarum aliarum quæ advolvuntur, fiat per unum ex his tribus modis; vel quod ista aquarum copia emanet ex interioribus terræ et rursus in illa se recipiat; vel quod non

sit aliqua amplior moles aquarum, sed quod eædem aquæ (non aucto quanto suo) extendantur sive rarefiant, ita ut majorem locum et dimensionem occupent, et rursus se contrahant; vel quod nec copia accedat major nec extensio amplior, sed eædem aquæ (prout sunt tam copia quam densitate aut raritate) per vim aliquam magneticam desuper eas attrahentem et evocantem, et per consensum, se attollant et deinde se remittant. Itaque reducatur (si placet) jam inquisitio (missis duobus illis motibus prioribus) ad hunc ultimum; et inquiratur si fiat aliqua talis sublatio per consensum sive vim magneticam. Atqui primo manifestum est universas aquas, prout ponuntur in fossa sive cavo maris, non posse simul attolli, quia defuerit quod succedat in fundo; adeo ut si foret in aquis aliquis hujusmodi appetitus se attollendi, ille ipse tamen a nexu rerum, sive (ut vulgo loquuntur) ne detur vacuum, fractus foret et cohibitus. Relinquitur, ut attollantur aquæ ex aliqua parte, et per hoc minuantur et cedant ex alia. Enimvero rursus necessario sequetur ut vis illa magnetica, cum super totum operari non possit, circa medium operetur intensissime; ita ut aquas in medio attollat, illæ vero sublatæ latera per successionem deserant et destituant.

Itaque jam tandem perventum est ad Instantiam Crucis circa hoc subjectum. Ea talis est: si inveniatur quod in refluxibus maris aquarum superficies in mari sit arcuata magis et rotunda, attollentibus se scilicet aquis in medio maris et deficientibus circa latera, quæ sunt litora; et in fluxibus eadem superficies sit magis plana et æqua, redeuntibus scilicet aquis ad priorem suam positionem; tum certe per hanc Instantiam Decisoriam potest recipi sublatio per vim magneticam, aliter

prorsus abjudicanda est. Hoc vero in fretis per lineas nauticas non difficile est experiri ;[1] videlicet utrum in refluxibus versus medium maris, mare non sit magis altum sive profundum quam in fluxibus. Notandum autem est, si hoc ita sit, fieri (contra ac creditur) ut attollant se aquæ in refluxibus, demittant se tantum in fluxibus, ita ut littora vestiant et inundent.

Similiter, sit natura inquisita Motus Rotationis spontaneus ; et speciatim, utrum Motus Diurnus, per quem sol et stellæ ad conspectum nostrum oriuntur et occidunt, sit motus rotationis verus in cœlestibus, aut motus apparens in cœlestibus, verus in terra. Poterit esse Instantia Crucis super hoc subjectem talis. Si inveniatur motus aliquis in oceano ab oriente in occidentem, licet admodum languidus et enervatus ; si idem motus reperiatur paulo incitatior in aëre, præsertim intra tropicos, ubi propter majores circulos est magis perceptibilis ; si idem motus reperiatur in humilioribus cometis, jam factus vivus et validus ; si idem motus reperiatur in planetis, ita tamen dispensatus et graduatus ut quo propius absit a terra sit tardior, quo longius celerior, atque in cœlo demum stellato sit velocissimus ; tum certe recipi debet motus diurnus pro vero in cœlis, et abnegandus est motus terræ ; quia manifestum erit, motum ab oriente in occidentem esse plane cosmicum et ex consensu universi, qui in summitatibus cœli maxime rapidus gradatim labascat, et tandem desinat et exstinguatur in immobili, videlicet terra.[2]

[1] It is scarcely necessary to remark that wherever soundings are possible, tidal phenomena are derivative, and give no direct information as to the form the ocean would assume if the hypothesis of the equilibrium theory represented the reality.

[2] Nothing shows better than an instance of this kind, the impossibility of reducing philosophical reasoning to a uniform method of exclusion.

Similiter, sit natura inquisita Motus Rotationis ille alter apud astronomos decantatus, renitens et contrarius Motui Diurno, videlicet ab occidente in orientem; quem veteres astronomi attribuunt planetis, etiam cœlo stellato; at Copernicus et ejus sectatores terræ quoque; et quæratur utrum inveniatur in rerum natura aliquis talis motus, an potius res conficta sit et supposita, ad compendia et commoditates calculationum, et ad pulchrum illud, scilicet de expediendis motibus cœlestibus per circulos perfectos. Neutiquam enim evincitur iste motus esse in supernis verus et realis, nec per defectum restitutionis planetæ in motu diurno ad idem punctum cœli stellati, nec per diversam politatem zodiaci, habito respectu ad polos mundi; quæ duo nobis hunc motum pepererunt. Primum enim phænomenon per anteversionem et derelictionem optime salvatur; secundum per lineas spirales; adeo ut inæqualitas restitutionis et declinatio ad tropicos possint esse potius modificationes motus unici illius diurni, quam motus renitentes aut circa diversos polos. Et certissimum est, si paulisper pro plebeiis nos geramus (missis astronomorum et scholæ commentis, quibus illud in more est ut sensui in multis immerito vim faciant, et obscuriora malint), talem esse motum istum ad sensum, qualem diximus; cujus imaginem per fila ferrea (veluti in machina) aliquando repræsentari fecimus.[1]

How could the analogical argument in the text be stated in accordance with what Bacon seems to recognise as the only true form of induction,—that, namely, which proceeds by exclusion? The argument depends on a wholly non-logical element, the conviction of the unity and harmony of nature.

[1] This passage does the author little credit. He does not seem to have perceived that the resolution of the apparent motion into other simpler motions was an essentially necessary step before the phenomena could be grouped together in any general law. The transition from the apparent

Verum Instantia Crucis super hoc subjectum poterit esse talis. Si inveniatur in aliqua historia fide digna, fuisse cometam aliquem vel sublimiorem vel humiliorem qui non rotaverit cum consensu manifesto (licet admodum irregulariter) Motus Diurni, sed potius rotaverit in contrarium cœli, tum certe hucusque judicandum est posse esse in natura aliquem talem motum. Sin nihil hujusmodi inveniatur, habendus est pro suspecto, et ad alias Instantias Crucis circa hoc confugiendum.

Similiter, sit natura inquisita, Pondus sive Grave. Bivium circa hanc naturam tale est. Necesse est ut gravia et ponderosa vel tendant ex natura sua ad centrum terræ, per proprium schematismum; vel ut a massa corporea ipsius terræ, tanquam a congregatione corporum connaturalium, attrahantur et rapiantur, et ad eam per consensum ferantur. At posterius hoc si in causa sit, sequitur ut quo propius gravia appropinquant ad terram, eo fortius et majore cum impetu ferantur ad eam; quo longius ab ea absint, debilius et tardius (ut fit in attractionibus magneticis); idque fieri intra spatium certum; adeo ut si elongata fuerint a terra tali distantia ut virtus terræ in ea agere non possit, pensilia mansura sint, ut et ipsa terra, nec omnino decasura.

Itaque talis circa hanc rem poterit esse Instantia Crucis. Sumatur horologium ex iis quæ moventur per pondera plumbea, et aliud ex iis quæ moventur per compressionem laminæ ferreæ; atque vere probentur, ne alterum altero velocius sit aut tardius; deinde ponatur

motion to the real motions could never have been made unless the former had been resolved in the manner which Bacon here condemns. From the concluding remark no astronomer would have dissented, "talem esse motum ad sensum, qualem diximus." About this there can be no question; but the whole passage shows how little Bacon understood the scope and the value of the astronomy of his own time.

horologium illud movens per pondera super fastigium alicujus templi altissimi, altero illo infra detento; et notetur diligenter si horologium in alto situm tardius moveatur quam solebat, propter diminutam virtutem ponderum. Idem fiat experimentum in profundis minerarum alte sub terra depressarum, utrum horologium hujusmodi non moveatur velocius quam solebat, propter auctam virtutem ponderum. Quod si inveniatur virtus ponderum minui in sublimi, aggravari in subterraneis, recipiatur pro causa ponderis attractio a massa corporea terræ.[1]

Similiter, sit natura inquisita Verticitas Acus Ferreæ, tactæ magnete. Circa hanc naturam tale erit bivium. Necesse est ut tactus magnetis vel ex se indat ferro verticitatem ad septentriones et austrum; vel ut excitet ferrum tantummodo et habilitet, motus autem ipse indatur ex præsentia terræ; ut Gilbertus opinatur, et tanto conatu probare nititur. Itaque huc spectant ea quæ ille perspicaci industria conquisivit. Nimirum quod clavus ferreus, qui diu duravit in situ versus septentri-

[1] Nothing can be more ingenious than the instantia crucis here proposed. A series of observations were made by Dr. Whewell and Mr. Airy to determine the effect on the time of vibration of a pendulum, produced by carrying it to the bottom of a mine; but, probably from the effect of local attractions, the results were scarcely as satisfactory as might have been expected. In the autumn of 1854, Mr. Airy instituted similar experiments in the Harton Colliery. They appear likely to afford more satisfactory results than the older series made at Dolcoath.

Voltaire cites the passage in the text in support of his remark that "le plus grand service, peut-être, que F. Bacon ait rendu à la philosophie a été de deviner l'attraction." But in reality the notion of attraction in one form or other (e. g. the attraction of the sea by the moon) sprang up in the infancy of physical speculation; and it cannot be affirmed that Bacon's ideas on the subject were as clear as those of his predecessor William Gilbert. (See note on *De Aug.* ii. 13.) By an error similar to Voltaire's, some of Dante's commentators have claimed for him the credit of being the first to indicate the true cause of the tides. The passage on which this claim is founded is in the *Paradiso*, xvi. 82.

ones et austrum, colligat mora diutina verticitatem, absque tactu magnetis; ac si terra ipsa, quæ ob distantiam debiliter operatur (namque superficies aut extima incrustatio terræ virtutis magneticæ, ut ille vult, expers est), per moram tamen longam magnetis tactum suppleret, et ferrum exciret, deinde excitum conformaret et verteret. Rursus, quod ferrum ignitum et candens, si in exstinctione sua exporrigatur inter septentriones et austrum, colligat quoque verticitatem absque tactu magnetis; ac si partes ferri in motu positæ per ignitionem, et postea se recipientes, in ipso articulo extinctionis suæ magis essent susceptivæ et quasi sensitivæ virtutis manantis a terra quam alias, et inde fierent tanquam excitæ. Verum hæc, licet bene observata, tamen non evincunt prorsus quod ille asserit.[1]

Instantia Crucis autem circa hoc subjectum poterit esse talis. Capiatur terrella[2] ex magnete, et notentur poli ejus; et ponantur poli terrellæ versus orientem et occasum, non versus septentriones et austrum, atque ita jaceant; deinde superponatur acus ferrea intacta, et permittatur ita manere ad dies sex aut septem. Acus vero (nam de hoc non dubitatur) dum manet super magnetem, relictis polis mundi, se vertet ad polos magnetis; itaque quamdiu ita manet, vertitur scilicet ad orientem et occidentem mundi. Quod si inveniatur acus illa, remota a magnete et posita super versorium, statim se applicare ad septentriones et austrum, vel

[1] See, for these two remarks, the twelfth chapter of the third book of Gilbert's treatise *De Magnete*. It is illustrated by a curious woodcut, representing the smith forging a bar of iron, and holding it, as he does so, in the plane of the meridian.

[2] Terrella is a word used by Gilbert to denote a spherical magnet. One of the fundamental ideas of his philosophy was that the earth was a great magnet; and a magnet of the same form was therefore called a *little earth*, or terrella. See, for instance, his treatise *De Magnete*, ii. cc. 7 & 8.

etiam paulatim se eo recipere, tum recipienda est pro causa, præsentia terræ; sin aut vertatur (ut prius) in orientem et occidentem, aut perdat verticitatem, habenda est illa causa pro suspecta, et ulterius inquirendum est.

Similiter, sit natura inquisita Corporea Substantia Lunæ; an sit tenuis, flammea, sive aërea, ut plurimi ex priscis philosophis opinati sunt; an solida et densa, ut Gilbertus et multi moderni, cum nonnullis ex antiquis, tenent.[1] Rationes posterioris istius opinionis fundantur in hoc maxime, quod luna radios solis reflectat; neque videtur fieri reflexio lucis nisi a solidis.

Itaque Instantiæ Crucis circa hoc subjectum eæ esse poterint (si modo aliquæ sint) quæ demonstrent reflexionem a corpore tenui, qualis est flamma, modo sit crassitiei sufficientis. Certe causa crepusculi, inter alias, est reflexio radiorum solis a superiore parte aëris. Etiam quandoque reflecti videmus radios solis temporibus vespertinis serenis a fimbriis nubium roscidarum, non minori splendore, sed potius illustriori et magis glorioso, quam qui redditur a corpore lunæ;[2] neque tamen constat eas nubes coaluisse in corpus densum aquæ. Etiam videmus aërem tenebrosum pone fenestras noctu reflectere lucem candelæ, non minus quam corpus densum. Tentandum etiam foret experimentum immissionis radiorum solis per foramen super flammam aliquam subfuscam et cæruleam. Sane radii aperti solis, incidentes in flammas obscuriores, videntur eas quasi mortificare, ut conspiciantur magis instar fumi albi quam flammæ. Atque hæc impræsentiarum occurrunt, quæ sint ex na-

[1] See Gilbert's *De Mundo*, &c., ii. c. 13 *et sqq.*

[2] The comparison of the brightness of the moon in the daytime with that of a cloud was ingeniously applied by Bouguer to determine the ratio of the moon's light to the sun's.

tura Instantiarum Crucis circa hanc rem; et meliora fortasse reperiri possunt. Sed notandum semper est, reflexionem a flamma non esse expectandam, nisi a flamma alicujus profunditatis; nam aliter vergit ad diaphanum. Hoc autem pro certo ponendum, lucem semper in corpore æquali aut excipi et transmitti aut resilire.

Similiter, sit natura inquisita Motus Missilium, veluti spiculorum, sagittarum, globulorum, per aërem. Hunc motum Schola (more suo) valde negligenter expedit; satis habens, si eum nomine motus violenti a naturali (quem vocant) distinguat; et quod ad primam percussionem sive impulsionem attinet, per illud, (*quod duo corpora non possint esse in uno loco, ne fiat penetratio dimensionum,*) sibi satisfaciat; et de processu continuato istius motus nihil curet. At circa hanc naturam bivium est tale: aut iste motus fit ab aëre vehente et pone corpus emissum se colligente, instar fluvii erga scapham aut venti erga paleas; aut a partibus ipsius corporis non sustinentibus impressionem, sed ad eandem laxandam per successionem se promoventibus. Atque priorem illum recipit Fracastorius, et fere omnes qui de hoc motu paulo subtilius inquisiverunt;[1] neque dubium est,

[1] See Fracastorius, *De Sympathiâ et Antipathiâ*, c. 4.

The notion that the air concurred in producing the continued motion of projectiles is found in the *Timæus*, p. 80. Plato has been speaking of respiration, of which his theory is, that the expiration of air through the nostrils and mouth pushes the contiguous external air from its place, which disturbs that near it, and so on until a circle is formed, whereby, by antiperistasis, air is forced in through the flesh to fill up the cavity of the chest — a circulation of air through the body, in short. On the same principle he would have explained a variety of other phenomena — the action of cupping instruments, swallowing, the motion of projectiles, &c. &c. All these, however, after suggesting the explanation, he leaves unexplained. But Plutarch, *Quæst. Platon.* x. (p. 177. of Reiske's *Plutarch*) developes a

quin sint aëris partes in hac re nonnullæ; sed alter motus proculdubio verus est, ut ex infinitis constat experimentis. Sed inter cæteras, poterit esse circa hoc subjectum Instantia Crucis talis; quod lamina, aut filum ferri paulo contumacius, vel etiam calamus sive penna in medio divisa, adducta et curvata inter pollicem et digitum, exiliant. Manifestum enim est, hoc non posse imputari aëri se pone corpus colligenti, quia fons motus est in medio laminæ vel calami, non in extremis.

Similiter sit natura inquisita motus ille rapidus et potens Expansionis Pulveris Pyrii in flammam; unde tantæ moles subvertuntur, tanta pondera emittuntur, quanta in cuniculis majoribus et bombardis videmus. Bivium circa hanc naturam tale est. Aut excitatur iste motus a mero corporis appetitu se dilatandi, postquam fuerit inflammatum; aut ab appetitu mixto spiritus crudi, qui rapide fugit ignem, et ex eo circumfuso, tanquam ex carcere, violenter erumpit. Schola autem et vulgaris opinio tantum versatur circa priorem illum appetitum. Putant enim homines se pulchre philosophari, si asserant flammam ex forma elementi necessitate quadam donari locum ampliorem occupandi quam idem corpus expleverat cum subiret formam pulveris, atque inde sequi motum istum. Interim minime advertunt, licet hoc verum sit, posito quod flamma generetur, tamen posse impediri flammæ generationem a tanta mole quæ illam comprimere et suffocare queat;

similar explanation in each case. I transcribe what he says of projectiles: — *Τὰ δὲ ῥιπτούμενα βάρη τὸν ἀέρα σχίζει μετὰ πληγῆς ἐκπεσόντα, καὶ διΐστησιν. ὁ δὲ περιῤῥέων ὀπίσω, τῷ φύσιν ἔχειν ἀεὶ τὴν ἐρημουμένην χώραν διώκειν καὶ ἀναπληροῦν, συνέπεται τῷ ἀφιεμένῳ, τὴν κίνησιν συνεπιταχύνων.* But this explanation is not Plato's, but Plutarch's; though it is probably what Plato would himself have said.

ut non deducatur res ad istam necessitatem de qua loquuntur. Nam quod necesse sit fieri expansionem, atque inde sequi emissionem aut remotionem corporis quod obstat, si generetur flamma, recte putant. Sed ista necessitas plane evitatur, si moles illa solida flammam supprimat antequam generetur. Atque videmus flammam, præsertim in prima generatione, mollem esse et lenem, et requirere cavum in quo experiri et ludere possit. Itaque tanta violentia huic rei per se assignari non potest. Sed illud verum; generationem hujusmodi flammarum flatulentarum, et veluti ventorum igneorum, fieri ex conflictu duorum corporum, eorumque naturæ inter se plane contrariæ; alterius admodum inflammabilis, quæ natura viget in sulphure; alterius flammam exhorrentis, qualis est spiritus crudus qui èst in nitro; adeo ut fiat conflictus mirabilis, inflammante se sulphure quantum potest (nam tertium corpus, nimirum carbo salicis, nil aliud fere præstat quam ut illa duo corpora incorporet et commode uniat), et erumpente spiritu nitri quantum potest, et una se dilatante (nam hoc faciunt et aër, et omnia cruda, et aqua, ut a calore dilatentur), et per istam fugam et eruptionem interim flammam sulphuris, tanquam follibus occultis, undequaque exufflante.

Poterant[1] autem esse Instantiæ Crucis circa hoc subjectum duorum generum. Alterum eorum corporum quæ maxime sunt inflammabilia, qualia sunt sulphur, caphura, naphtha, et hujusmodi, cum eorum misturis; quæ citius et facilius concipiunt flammam quam pulvis pyrius, si non impediantur; ex quo liquet appetitum inflammandi per se effectum illum stupendum non operari. Alterum eorum quæ flammam fugiunt et exhor-

[1] So in the original. — *J. S.*

rent, qualia sunt sales omnes. Videmus enim, si jaciantur in ignem, spiritum aqueum erumpere cum fragore antequam flamma concipiatur; quod etiam leniter fit in foliis paulo contumacioribus, parte aquea erumpente antequam oleosa concipiat flammam. Sed maxime cernitur hoc in argento vivo, quod non male dicitur aqua mineralis.[1] Hoc enim, absque inflammatione, per eruptionem et expansionem simplicem vires pulveris pyrii fere adæquat; quod etiam admixtum pulveri pyrio ejus vires multiplicare dicitur.

Similiter sit natura inquisita, Transitoria Natura Flammæ, et extinctio ejus momentanea. Non enim videtur natura flammea hic apud nos figi et consistere, sed singulis quasi momentis generari, et statim extingui. Manifestum enim est, in flammis quæ hic continuantur et durant, istam durationem non esse ejusdem flammæ in individuo, sed fieri per successionem novæ flammæ seriatim generatæ, minime autem manere eandem flammam numero; id quod facile perspicitur ex hoc, quod, substracto alimento sive fomite flammæ, flamma statim pereat. Bivium autem circa hanc naturam tale est. Momentanea ista natura aut fit remittente se causa quæ eam primo genuit, ut in lumine, sonis, et motibus (quos vocant) violentis; aut quod flamma in natura sua possit hic apud nos manere, sed a contrariis naturis circumfusis vim patiatur et destruatur.

Itaque poterit esse circa hoc subjectum Instantia Crucis talis. Videmus flammas in incendiis majoribus, quam alte in sursum ascendant. Quanto enim basis flammæ est latior, tanto vertex sublimior. Itaque vide-

[1] It is well known that the expansive force of the vapour of mercury at high temperatures is enormous.

tur principium extinctionis fieri circa latera, ubi ab aëre flamma comprimitur et male habetur. At meditullia flammæ, quæ aër non contingit sed alia flamma undique circumdat, eadem numero manent, neque extinguuntur donec paulatim angustientur ab aëre per latera circumfuso. Itaque omnis flamma pyramidalis est basi circa fomitem largior, vertice autem (inimicante aëre, nec suppeditante fomite) acutior. At fumus, angustior circa basin, ascendendo dilatatur, et fit tanquam pyramis inversa; quia scilicet aër fumum recipit, flammam (neque enim quispiam somniet aërem esse flammam accensam, cum sint corpora plane heterogenea) comprimit.

Accuratior autem poterit esse Instantia Crucis ad hanc rem accommodata, si res forte manifestari possit per flammas bicolores. Capiatur igitur situla parva ex metallo, et in ea figatur parva candela cerea accensa; ponatur situla in patera, et circumfundatur spiritus vini in modica quantitate, quæ ad labra situlæ non attingat; tum accende spiritum vini. At spiritus ille vini exhibebit flammam magis scilicet cæruleam, lychnus candelæ autem magis flavam. Notetur itaque utrum flamma lychni (quam facile est per colorem a flamma spiritus vini distinguere, neque enim flammæ, ut liquores, statim commiscentur) maneat pyramidalis, an potius magis tendat ad formam globosam, cum nihil inveniatur quod eam destruat aut comprimat.[1] At hoc posterius si fiat, manere flammam eandem numero, quamdiu intra aliam flammam concludatur nec vim inimicam aëris experiatur, pro certo ponendum est.

Atque de Instantiis Crucis hæc dicta sint. Longiores autem in iis tractandis ad hunc finem fuimus,

[1] This experiment is mentioned as actually tried in *Syl. Sylvarum*, 31. [See note on the passage. — *J. S.*]

ut homines paulatim discant et assuefiant de natura judicare per Instantias Crucis et experimenta lucifera, et non per rationes probabiles.

XXXVII.

Inter Prærogativas Instantiarum, ponemus loco decimo quinto *Instantias Divortii;* quæ indicant separationes naturarum earum quæ ut plurimum occurrunt. Differunt autem ab Instantiis quæ subjunguntur Instantiis Comitatus; quia illæ indicant separationes naturæ alicujus ab aliquo concreto cum quo illa familiariter consuescit, hæ vero separationes naturæ alicujus ab altera natura. Differunt etiam ab Instantiis Crucis; quia nihil determinant, sed monent tantum de separabilitate unius naturæ ab altera. Usus autem earum est ad prodendas falsas Formas, et dissipandas leves contemplationes ex rebus obviis orientes; adeo ut veluti plumbum et pondera intellectui addant.

Exempli gratia: sint naturæ inquisitæ quatuor naturæ illæ, quas *Contubernales* vult esse Telesius,[1] et tanquam ex eadem camera; viz. Calidum, Lucidum, Tenue, Mobile sive promptum ad motum. At plurimæ inveniuntur Instantiæ Divortii inter ipsas. Aër enim tenuis est et habilis ad motum, non calidus aut lucidus;

[1] The fundamental idea of Telesius's philosophy is, that heat and cold are the great constituent principles of the universe, and that the antithesis between them corresponds to that which he recognises between the sun and the earth: — "Omnino calidus, tenuis, candidus, mobilisque est Sol; Terra contra frigida, crassa, immobilis, tenebricosaque .... unum Sol in terram emittens calorem ejus naturam facultatesque et conditiones ex eâ deturbat omnes, suasque ei indit; et eodem ferme modo quo Sol terram, etiam calor quivis, vel qui e commotis contritisque enascitur rebus, quæ corripit exuperatque immutare videtur; frigus scilicet ex iis, ejusque facultates conditionesque omnes, crassitiem, obscuritatem, immobilitatem, deturbare, et se ipsum iis, propriasque facultates conditionesque omnes, tenuitatem, albedinem et mobilitatem, indere ..... videtur." — *De Rerum Naturâ*, i. c. 1

luna lucida, absque calore ; aqua fervens calida, absque lumine ; motus acus ferreæ super versorium pernix et agilis, et tamen in corpore frigido, denso, opaco ; et complura id genus.

Similiter sint naturæ inquisitæ Natura Corporea et Actio Naturalis. Videtur enim non inveniri actio naturalis, nisi subsistens in aliquo corpore. Attamen possit fortasse esse circa hanc rem Instantia nonnulla Divortii. Ea est actio magnetica, per quam ferrum fertur ad magnetem, gravia ad globum terræ. Addi etiam possint aliæ nonnullæ operationes ad distans. Actio siquidem hujusmodi et in tempore fit, per momenta non in puncto temporis, et in loco, per gradus et spatia. Est itaque aliquod momentum temporis, et aliquod intervallum loci, in quibus ista virtus sive actio hæret in medio inter duo illa corpora quæ motum cient. Reducitur itaque contemplatio ad hoc ; utrum illa corpora quæ sunt termini motus disponant vel alterent corpora media, ut per successionem et tactum verum labatur virtus a termino ad terminum, et interim subsistat in corpore medio ; an horum nihil sit, præter corpora et virtutem et spatia ? Atque in radiis opticis et sonis et calore et aliis nonnullis operantibus ad distans, probabile est media corpora disponi et alterari ; eo magis, quod requiratur medium qualificatum ad deferendam operationem talem. At magnetica illa sive coitiva virtus admittit media tanquam adiaphora, nec impeditur virtus in omnigeno medio. Quod si nil rei habeat virtus illa aut actio cum corpore medio, sequitur quod sit virtus aut actio naturalis ad tempus nonnullum et in loco nonnullo subsistens sine corpore ; cum neque subsistat in corporibus terminantibus, nec in mediis. Quare actio magnetica poterit esse Instantia Divortii

circa naturam corpoream et actionem naturalem. Cui hoc adjici potest tanquam corollarium aut lucrum non prætermittendum: viz. quod etiam secundum sensum philosophanti sumi possit probatio[1] quod sint entia et substantiæ separatæ et incorporeæ. Si enim virtus et actio naturalis, emanans a corpore, subsistere possit aliquo tempore et aliquo loco omnino sine corpore; prope est ut possit etiam emanare in origine sua a substantia incorporea. Videtur enim non minus requiri natura corporea ad actionem naturalem sustentandam et devehendam, quam ad excitandam aut generandam.

XXXVIII.

Sequuntur quinque ordines instantiarum, quas uno vocabulo generali *Instantias Lampadis* sive *Informationis Primæ* appellare consuevimus. Eæ sunt quæ auxiliantur sensui. Cum enim omnis Interpretatio Naturæ incipiat a sensu, atque a sensuum perceptionibus recta, constanti, et munita via ducat ad perceptiones intellectus, quæ sunt notiones veræ et axiomata, necesse est ut quanto magis copiosæ et exactæ fuerint repræsentationes sive præbitiones ipsius sensus, tanto omnia cedant facilius et fœlicius.

Harum autem quinque Instantiarum Lampadis, primæ roborant, ampliant, et rectificant actiones sensus immediatas: secundæ deducunt non-sensibile ad sensibile;[2] tertiæ indicant processus continuatos sive series earum rerum et motuum quæ (ut plurimum) non notantur nisi in exitu aut periodis; quartæ aliquid substituunt sensui in meris destitutionibus; quintæ excitant

[1] *i. e.* a proof furnished by merely human philosophy.

[2] *i. e.* make manifest things which are not directly perceptible, by means of others which are.

attentionem sensus et advertentiam, atque una limitant subtilitatem rerum. De his autem singulis jam dicendum est.

XXXIX.

Inter Prærogativas Instantiarum, ponemus loco decimo sexto *Instantias Januæ* sive *Portæ:* eo enim nomine eas appellamus quæ juvant actiones sensus immediatas. Inter sensus autem manifestum est partes primas tenere Visum, quoad informationem; quare huic sensui præcipue auxilia conquirenda. Auxilia autem triplicia esse posse videntur; vel ut percipiat non visa; vel ut majore intervallo; vel ut exactius et distinctius.

Primi generis sunt (missis bis-oculis et hujusmodi, quæ valent tantum ad corrigendam et levandam infirmitatem visus non bene dispositi, atque ideo nihil amplius informant) ea quæ nuper inventa sunt perspicilla; quæ latentes et invisibiles corporum minutias, et occultos schematismos et motus (aucta insigniter specierum magnitudine) demonstrant; quorum vi, in pulice, musca, vermiculis, accurata corporis figura et lineamenta, necnon colores et motus prius non conspicui, non sine admiratione cernuntur. Quinetiam aiunt[1] lineam rectam calamo vel penecillo descriptam, per hujusmodi perspicilla inæqualem admodum et tortuosam cerni; quia scilicet nec motus manus, licet per regulam adjutæ, nec impressio atramenti aut coloris revera æqualia existant; licet illæ inæqualitates tam minutæ sint ut sine adjumento hujusmodi perspicillorum conspici nequeant. Etiam superstitiosam quandam observationem in hac re (ut fit in rebus novis et miris)

[1] Compare *Aph.* xiii. § 28. "Specula comburentia, in quibus (*ut memini*) hoc fit," &c. It would appear from the passage in the text that Bacon had not even seen one of the newly invented microscopes. —*J. S.*

addiderunt homines: viz. quod hujusmodi perspicilla opera naturæ illustrent, artis dehonestent. Illud vero nihil aliud est quam quod texturæ naturales multo subtiliores sint quam artificiosæ.[1] Perspicillum enim illud ad minuta tantum valet: quale perspicillum si vidisset Democritus, exiluisset forte, et modum videndi atomum (quem ille invisibilem omnino affirmavit) inventum fuisse putasset.[2] Verum incompetentia hujusmodi perspicillorum, præterquam ad minutias tantum (neque ad ipsas quoque, si fuerint in corpore majusculo), usum rei destruit. Si enim inventum extendi posset ad corpora majora, aut corporum majorum minutias, adeo ut textura panni lintei conspici posset tanquam rete, atque hoc modo minutiæ latentes et inæqualitates gemmarum, liquorum, urinarum, sanguinis, vulnerum, et multarum aliarum rerum, cerni possent, magnæ proculdubio ex eo invento commoditates capi possent.

Secundi generis sunt illa altera perspicilla quæ memorabili conatu adinvenit Galilæus; quorum ope, tanquam per scaphas aut naviculas, aperiri et exerceri possint propiora cum cœlestibus commercia. Hinc enim constat, galaxiam esse nodum sive coacervationem stellarum parvarum, plane numeratarum et distinctarum; de qua re apud antiquos tantum suspicio fuit. Hinc demonstrari videtur, quod spatia orbium (quos vocant)

[1] Leibnitz goes as far as to say, "La matière arrangée par une sagesse divine doit être essentiellement organisée partout; . . . il y a machine dans les parties de la machine naturelle à l'infini." — *Sur le Principe de Vie*, p. 431. of Erdmann's edition.

[2] Democritus maintained that the atom was wholly incognisable by the senses. Thus Sextus Empiricus mentions him along with Plato as having held the doctrine *μόνα τὰ νοητὰ ἀληθῆ εἶναι*; the reason in the case of Democritus being that his atoms, which alone he recognised as realities possessed *πάσης αἰσθητῆς ποιότητος ἔρημον φύσιν*. — *Sext. Em Advers Logicos*, ii. § 6.

planetarum non sint plane vacua aliis stellis, sed quod cœlum incipiat stellescere antequam ad cœlum ipsum stellatum ventum sit; licet stellis minoribus quam ut sine perspicillis istis conspici possint. Hinc choreas illas stellarum parvarum circa planetam Jovis (unde conjici possit esse in motibus stellarum plura centra) intueri licet. Hinc inæqualitates luminosi et opaci in luna distinctius cernuntur et locantur; adeo ut fieri possit quædam seleno-graphia. Hinc maculæ in sole, et id genus: omnia certe inventa nobilia, quatenus fides hujusmodi demonstrationibus tuto adhiberi possit.[1] Quæ nobis ob hoc maxime suspectæ sunt, quod in istis paucis sistatur experimentum, neque alia complura investigatu æque digna eadem ratione inventa sint.[2]

[1] Galileo often mentions the attempt which many of the Peripaticians made to set aside all arguments founded on his discoveries with the telescope, by saying that they were mere optical delusions. J. C. La Galla, in his dissertation *De Phænominis in Orbe Lunæ*, has a section entitled "De Telescopii Veritate," in which, though an Aristotelian, he has nevertheless admitted that this objection is untenable.

[2] Compare this with the passage in the *Descriptio Globi Intellectualis* (c. v.) where Bacon speaks of Galileo's invention and discoveries (the first-fruits of which had just been announced) in a strain of more sanguine expectation: — "Atque hoc inceptum et fine et aggressu nobile quoddam et humano genere dignum esse existimamus: eo magis quod hujusmodi homines et ausu laudandi sint et fide; quod ingenue et perspicue proposuerunt, quomodo singula illis constiterint Superest tantum constantia, cum magnâ judicii severitate, ut et instrumenta mutent, et testium numerum augeant, et singula et sæpe experiantur, et varie; denique ut et sibi ipsi objiciant et aliis patefaciant quid in contrarium objici possit, et tenuissimum quemque scrupulum non spernant; ne forte illis eveniat, quod Democriti et aniculæ suæ evenit circa ficus mellitas, ut vetula esset philosopho prudentior, et magnæ et admirabilis speculationis causæ subesset error quispiam tenuis et ridiculus." From this passage, written eight years before, we may learn (I think) why it was that Bacon had now begun to doubt how far these observations could be trusted. Believing, as he did, that all the received theories of the heavens were full of error, as soon as he heard that by means of the telescope men could really see so much further into the heavens than before, he was prepared to hear of a great number of new and unexpected phenomena; and his only fear was that the observers, instead

Tertii generis sunt bacilla illa ad terras mensurandas, astrolabia, et similia; quæ sensum videndi non ampliant, sed rectificant et dirigunt. Quod si sint aliæ instantiæ quæ reliquos sensus juvent in ipsorum actionibus immediatis et individuis, tamen si ejusmodi sint quæ informationi ipsi nihil addant plus quam jam habetur, ad id quod nunc agitur non faciunt. Itaque earum mentionem non fecimus.

XL.

Inter Prærogativas Instantiarum, ponemus loco decimo septimo *Instantias Citantes*, sumpto vocabulo a foris civilibus, quia citant ea ut compareant quæ prius non comparuerunt; quas etiam *Instantias Evocantes* appellare consuevimus. Eæ deducunt non-sensibile ad sensibile.

Sensum autem fugiunt res, vel propter distantiam objecti locati; vel propter interceptionem sensus per corpora media; vel quia objectum non est habile ad impressionem in sensu faciendam; vel quia deficit quantum in objecto pro feriendo sensu; vel quia tempus non est proportionatum ad actuandum sensum; vel quia objecti percussio non toleratur a sensu; vel quia objectum ante implevit et possedit sensum, ut novo motui non sit locus. Atque hæc præcipue ad visum pertinent, et deinde ad tactum. Nam hi duo sensus sunt informativi ad largum, atque de commu-

of following out their observations patiently and carefully, would begin to form new theories. But now that nine years had passed since the discovery of Jupiter's satellites, the spots in the sun, &c., and no new discovery of importance had been announced, he wondered how it could be that men seeing so much further should be able to see so little more than they did, and began to suspect that it was owing to some defect either in the instrument or in the methods of observation. — *J. S.*

nibus objectis; ubi reliqui tres non informent fere nisi immediate et de propriis objectis.

In primo genere non fit deductio ad sensibile, nisi rei quæ cerni non possit propter distantiam adjiciatur aut substituatur alia res quæ sensum magis e longinquo provocare et ferire possit: veluti in significatione rerum per ignes, campanas, et similia.

In secundo genere fit deductio, cum ea quæ interius propter interpositionem corporum latent, nec commode aperiri possunt, per ea quæ sunt in superficie, aut ab interioribus effluunt, perducuntur ad sensum: ut status humanorum corporum per pulsus, et urinas, et similia.

At tertii et quarti generis deductiones ad plurima spectant, atque undique in rerum inquisitione sunt conquirendæ. Hujus rei exempla sunt. Patet quod aër, et spiritus, et hujusmodi res quæ sunt toto corpore tenues et subtiles, nec cerni nec tangi possint. Quare in inquisitione circa hujusmodi corpora deductionibus omnino est opus.

Sit itaque natura inquisita Actio et Motus Spiritus qui includitur in corporibus tangibilibus. Omne enim tangibile apud nos continet spiritum invisibilem et intactilem, eique obducitur atque eum quasi vestit. Hinc fons triplex potens ille et mirabilis processus spiritus in corpore tangibili. Spiritus enim in re tangibili, emissus, corpora contrahit et desiccat; detentus, corpora intenerat et colliquat; nec prorsus emissus nec prorsus detentus, informat, membrificat, assimilat, egerit, organizat, et similia. Atque hæc omnia deducuntur ad sensibile per effectus conspicuos.

Etenim in omni corpore tangibili inanimato, spiritus inclusus primo multiplicat se, et tanquam depascit partes tangibiles eas quæ sunt maxime ad hoc faciles et præ-

paratæ, easque digerit et conficit et vertit in spiritum, et deinde una evolant. Atque hæc confectio et multiplicatio spiritus deducitur ad sensum per diminutionem ponderis. In omni enim dessicatione, aliquid defluit de quanto; neque id ipsum ex spiritu tantum præinexistente, sed ex corpore quod prius fuit tangibile et noviter versum est: spiritus enim non ponderat. Egressus autem sive emissio spiritus deducitur ad sensibile in rubigine metallorum, et aliis putrefactionibus ejus generis quæ sistunt se antequam pervenerint ad rudimenta vitæ; nam illa[1] ad tertium genus processus pertinent. Etenim in corporibus magis compactis spiritus non invenit poros et meatus per quos evolet; itaque cogitur partes ipsas tangibiles protrudere et ante se agere, ita ut illæ simul exeant; atque inde fit rubigo, et similia. At contractio partium tangibilium, postquam aliquid de spiritu fuerit emissum (unde sequitur illa desiccatio), deducitur ad sensibile tum per ipsam duritiem rei auctam, tum multo magis per scissuras, angustiationes, corrugationes, et complicationes corporum, quæ inde sequuntur. Etenim partes ligni desiliunt et angustiantur; pelles corrugantur; neque id solum, sed (si subita fuerit emissio spiritus per calorem ignis) tantum properant ad contractionem ut se complicent et convolvant.

At contra, ubi spiritus detinetur, et tamen dilatatur et excitatur per calorem aut ejus analoga (id quod fit in corporibus magis solidis aut tenacibus), tum vero corpora emolliuntur, ut ferrum candens; fluunt, ut metalla; liquefiunt, ut gummi, cera, et similia. Itaque contrariæ illæ operationes caloris (ut ex eo alia durescant, alia liquescant) facile conciliantur; quia in illis spiritus emitti-

[1] "Illæ" in the original edition, which must be wrong.

tur, in his agitatur et detinetur: quorum posterius est actio propria caloris et spiritus; prius, actio partium tangibilium tantum per occasionem spiritus emissi.

Ast ubi spiritus nec detinetur prorsus nec prorsus emittitur, sed tantum inter claustra sua tentat et experitur, atque nacta est partes tangibiles obedientes et sequaces in promptu, ita ut quo spiritus agit eæ simul sequantur; tum vero sequitur efformatio in corpus organicum, et membrificatio, et reliquæ actiones vitales, tam in vegetabilibus quam in animalibus. Atque hæc maxime deducuntur ad sensum per notationes diligentes primorum incœptuum et rudimentorum sive tentamentorum vitæ in animalculis ex putrefactione natis: ut in ovis formicarum, vermibus, muscis, ranis post imbrem, etc. Requiritur autem ad vivificationem et lenitas caloris et lentor corporis; ut spiritus nec per festinationem erumpat, nec per contumaciam partium coerceatur; quin potius ad ceræ modum illas plicare et effingere possit.

Rursus, differentia illa spiritus, maxime nobilis et ad plurima pertinens, (viz. spiritus abscissi, ramosi simpliciter, ramosi simul et cellulati; ex quibus prior est spiritus omnium corporum inanimatorum, secundus vegetabilium, tertius animalium), per plurimas instantias deductorias tanquam sub oculos ponitur.

Similiter patet, quod subtiliores texturæ et schematismi rerum (licet toto corpore visibilium aut tangibilium) nec cernantur nec tangantur. Quare in his quoque per deductionem procedit informatio. At differentia schematismorum maxime radicalis et primaria sumitur ex copia vel paucitate materiæ quæ subit idem spatium sive dimensum. Reliqui enim schematismi (qui referuntur ad dissimilaritates partium quæ in eodem cor-

pore continentur, et collocationes ac posituras earundem) præ illo altero sunt secundarii.

Sit itaque natura inquisita Expansio sive Coitio Materiæ in corporibus respective: viz. quantum materiæ impleat quantum dimensum in singulis. Etenim nil verius in natura quam propositio illa gemella, *ex nihilo nihil fieri*, neque *quicquam in nihilum redigi;* verum quantum ipsum materiæ sive summam totalem constare, nec augeri aut minui.[1] Nec illud minus verum, *ex quanto illo materiæ sub iisdem spatiis sive dimensionibus, pro diversitate corporum, plus et minus contineri;* ut in aqua plus, in aëre minus; adeo ut si quis asserat aliquod contentum aquæ in par contentum aëris verti posse, idem sit ac si dicat aliquid posse redigi in nihilum; contra, si quis asserat aliquod contentum aëris in par contentum aquæ verti posse, idem sit ac si dicat aliquid posse fieri ex nihilo. Atque ex copia ista et paucitate materiæ notiones illæ Densi et Rari, quæ varie et promiscue accipiuntur, proprie abstrahuntur. Assumenda est et assertio illa tertia, etiam satis certa: quod hoc de quo loquimur plus et minus materiæ in corpore hoc vel illo ad calculos (facta collatione) et proportiones exactas aut exactis propinquas reduci possit. Veluti si quis dicat inesse in dato contento auri talem coacervationem materiæ, ut opus habeat spiritus vini, ad tale quantum materiæ æquandum, spatio vicies et semel majore quam implet aurum, non erraverit.

Coacervatio autem materiæ et rationes ejus deducuntur ad sensibile per pondus. Pondus enim respon-

[1] It is worth remarking that Bacon here asserts as absolutely certain a maxim which is assuredly no result of experience. The same doctrine is as distinctly, though not so emphatically, asserted by Telesius, i. c. 5.

det copiæ materiæ, quoad partes rei tangibilis; spiritus autem, et ejus quantum ex materia, non venit in computationem per pondus; levat enim pondus potius quam gravat. At nos hujus rei tabulam fecimus satis accuratam; in qua pondera et spatia singulorum metallorum, lapidum præcipuorum, lignorum, liquorum, oleorum, et plurimorum aliorum corporum tam naturalium quam artificialium, excepimus;[1] rem polychrestam, tam ad lucem informationis quam ad normam operationis; et quæ multas res revelet omnino præter expectatum. Neque illud pro minimo habendum est, quod demonstret omnem varietatem quæ in corporibus tangibilibus nobis notis versatur (intelligimus autem corpora bene unita, nec plane spongiosa et cava et magna ex parte aëre impleta) non ultra rationes partium 21 excedere: tam finita scilicet est natura, aut saltem illa pars ejus cujus usus ad nos maxime pertinet.

Etiam diligentiæ nostræ esse putavimus, experiri si forte capi possint rationes corporum non-tangibilium sive pneumaticorum, respectu corporum tangibilium. Id quod tali molitione aggressi sumus. Phialam vitream accepimus, quæ unciam fortasse unam capere possit; parvitate vasis usi, ut minori cum calore posset fieri evaporatio sequens. Hanc phialam spiritu vini implevimus fere ad collum; eligentes spiritum vini, quod per tabulam priorem eum esse ex corporibus tangibilibus (quæ bene unita, nec cava sunt) rarissimum, et minimum continens materiæ sub suo dimenso, observarimus. Deinde pondus aquæ cum phiala ipsa ex-

[1] For a full account of the methods of determining specific gravities employed respectively by Porta, Ghetaldo, and Bacon, see preface to *Historia Densi et Rari*. — *J. S.*

acte notavimus. Postea vesicam accepimus, quæ circa duas pintas contineret. Ex ea aërem omnem, quoad fieri potuit, expressimus eo usque ut vesicæ ambo latera essent contigua: etiam prius vesicam oleo oblevimus cum fricatione leni, quo vesica esset clausior: ejus, si qua erat, porositate oleo obturata. Hanc vesicam circa os phialæ, ore phialæ intra os vesicæ recepto, fortiter ligavimus; filo parum cerato, ut melius adhæresceret et arctius ligaret. Tum demum phialam supra carbones ardentes in foculo collocavimus. At paulo post vapor sive aura spiritus vini, per calorem dilatati et in pneumaticum versi, vesicam paulatim sufflavit, eamque universam veli instar undequaque extendit. Id postquam factum fuit, continuo vitrum ab igne removimus, et super tapetem posuimus ne frigore disrumperetur; statim quoque in summitate vesicæ foramen fecimus, ne vapor cessante calore in liquorem restitutus resideret, et rationes confunderet. Tum vero vesicam ipsam sustulimus, et rursus pondus excepimus spiritus vini qui remanebat. Inde quantum consumptum fuisset in vaporem seu pneumaticum computavimus; et facta collatione quantum locum sive spatium illud corpus implesset quando esset spiritus vini in phiala, et rursus quantum spatium impleverit postquam factum fuisset pneumaticum in vesica, rationes subduximus; ex quibus manifeste liquebat, corpus istud ita versum et mutatum expansionem centuplo majorem quam antea habuisset acquisivisse.

Similiter sit natura inquisita Calor aut Frigus; ejus nempe gradus, ut a sensu non percipiantur ob debilitatem. Hæc deducuntur ad sensum per vitrum calendare, quale superius descripsimus. Calor enim et frigus, ipsa non percipiuntur ad tactum; at calor aërem expan-

dit, frigus contrahit. Neque rursus illa expansio et contractio aëris percipitur ad visum; at aër ille expansus aquam deprimit, contractus attollit; ac tum demum fit deductio ad visum, non ante, aut alias.

Similiter sit natura inquisita Mistura Corporum; viz. quid habeant ex aqueo, quid ex oleoso, quid ex spiritu, quid ex cinere et salibus, et hujusmodi; vel etiam (in particulari) quid habeat lac butyri, quid coaguli, quid seri, et hujusmodi. Hæc deducuntur ad sensum per artificiosas et peritas separationes, quatenus ad tangibilia. At natura spiritus in ipsis, licet immediate non percipiatur, tamen deprehenditur per varios motus et nixus corporum tangibilium in ipso actu et processu separationis suæ; atque etiam per acrimonias, corrosiones, et diversos colores, odores, et sapores eorundem corporum post separationem. Atque in hac parte, per distillationes atque artificiosas separationes, strenue sane ab hominibus elaboratum est; sed non multo fœlicius quam in cæteris experimentis, quæ adhuc in usu sunt: modis nimirum prorsus palpatoriis, et viis cæcis, et magis operose quam intelligenter; et (quod pessimum est) nulla cum imitatione aut æmulatione naturæ, sed cum destructione (per calores vehementes aut virtutes nimis validas) omnis subtilioris schematismi, in quo occultæ rerum virtutes et consensus præcipue sitæ sunt. Neque illud etiam, quod alias monuimus, hominibus in mentem aut observationem venire solet in hujusmodi separationibus: hoc est, plurimas qualitates, in corporum vexationibus tam per ignem quam alios modos, indi ab ipso igne iisque corporibus quæ ad separationem adhibentur, quæ in composito prius non fuerunt; unde miræ fallaciæ. Neque enim scilicet vapor universus, qui ex aqua emittitur per ignem, vapor aut aër antea

fuit in corpore aquæ; sed factus est maxima ex parte per dilatationem aquæ ex calore ignis.

Similiter in genere omnes exquisitæ probationes corporum sive naturalium sive artificialium, per quas vera dignoscuntur ab adulterinis, meliora a vilioribus, huc referri debent: deducunt enim non-sensibile ad sensibile. Sunt itaque diligenti cura undique conquirendæ.

Quintum vero genus latitantiæ quod attinet, manifestum est actionem sensus transigi in motu, motum in tempore. Si igitur motus alicujus corporis sit vel tam tardus vel tam velox ut non sit proportionatus ad momenta in quibus transigitur actio sensus, objectum omnino non percipitur; ut in motu indicis horologii, et rursus in motu pilæ sclopeti. Atque motus qui ob tarditatem non percipitur, facile et ordinario deducitur ad sensum per summas motus; qui vero ob velocitatem, adhuc non bene mensurari consuevit; sed tamen postulat inquisitio naturæ ut hoc fiat in aliquibus.

Sextum autem genus, ubi impeditur sensus propter nobilitatem objecti, recipit deductionem, vel per elongationem majorem objecti a sensu; vel per hebetationem objecti per interpositionem medii talis, quod objectum debilitet, non annihilet; vel per admissionem et exceptionem objecti reflexi, ubi percussio directa sit nimis fortis; ut solis in pelvi aquæ.

Septimum autem genus latitantiæ, ubi sensus ita oneratur objecto ut novæ admissioni non sit locus, non habet fere locum nisi in olfactu et odoribus; nec ad id quod agitur multum pertinet. Quare de deductionibus non-sensibilis ad sensibile, hæc dicta sint.[1]

[1] An excellent instance of the "deductio nonsensibilis ad sensibile" [in the second kind] occurs in the experiments recently made by Messrs. Hop-

Quandoque tamen deductio fit non ad sensum hominis, sed ad sensum alicujus alterius animalis cujus sensus in aliquibus humanum excellet: ut nonnullorum odorum, ad sensum canis; lucis, quæ in aëre non extrinsecus illuminato latenter existit, ad sensum felis, noctuæ, et hujusmodi animalium quæ cernunt noctu. Recte enim notavit Telesius, etiam in aëre ipso inesse lucem quandam originalem, licet exilem et tenuem, et maxima ex parte oculis hominum aut plurimorum animalium non inservientem; quia illa animalia, ad quorum sensum hujusmodi lux est proportionata, cernant noctu; id quod vel sine luce fieri, vel per lucem internam, minus credibile est.

Atque illud utique notandum est, de destitutionibus sensuum eorumque remediis hic nos tractare. Nam fallaciæ sensuum ad proprias inquisitiones de sensu et sensibili remittendæ sunt; excepta illa magna fallacia sensuum, nimirum quod constituant lineas rerum[1] ex analogia hominis, et non ex analogia universi; quæ non corrigitur nisi per rationem et philosophiam universalem.

XLI.

Inter Prærogativas Instantiarum, ponemus loco decimo octavo *Instantias Viæ*, quas etiam *Instantias Itine-*

kins and Joule for determining the melting-point of substances subjected to great pressure. The substance acted on is enclosed in a tube out of reach and sight. But a bit of magnetized steel has previously been introduced into it, and is supported by it as long as it remains solid. A magnetic needle is placed beside the apparatus, a certain amount of deviation being, of course, produced by the steel within the tube. The moment the temperature reaches the melting-point, the steel sinks; and its doing so is indicated by the motion of the needle.

[1] This phrase may, I think, be rendered "trace the outlines of outward objects." I have already remarked on the meaning of "ex analogiâ." [See note on *Distributio Operis*, p. 218. — *J. S.*]

rantes et *Instantias Articulatas* appellare consuevimus. Eæ sunt quæ indicant naturæ motus gradatim continuatos. Hoc autem genus instantiarum potius fugit observationem quam sensum. Mira enim est hominum circa hanc rem indiligentia. Contemplantur siquidem naturam tantummodo desultorie et per periodos, et postquam corpora fuerint absoluta ac completa, et non in operatione sua. Quod si artificis alicujus ingenia et industriam explorare et contemplari quis cuperet, is non tantum materias rudes artis atque deinde opera perfecta conspicere desideraret, sed potius præsens esse cum artifex operatur et opus suum promovet. Atque simile quiddam circa naturam faciendum est. Exempli gratia; si quis de vegetatione plantarum inquirat, ei inspiciendum est ab ipsa satione seminis alicujus (id quod per extractionem, quasi singulis diebus, seminum quæ per biduum, triduum, quatriduum, et sic deinceps, in terra manserunt, eorumque diligentem intuitum, facile fieri potest), quomodo et quando semen intumescere et turgere incipiat et veluti spiritu impleri; deinde quomodo corticulam rumpere et emittere fibras, cum latione nonnulla sui interim sursum, nisi terra fuerit admodum contumax; quomodo etiam emittat fibras, partim radicales deorsum, partim cauliculares sursum, aliquando serpendo per latera, si ex ea parte inveniat terram apertam et magis facilem; et complura id genus. Similiter facere oportet circa exclusionem ovorum; ubi facile conspici dabitur processus vivificandi et organizandi, et quid et quæ partes fiant ex vitello, quid ex albumine ovi, et alia. Similis est ratio circa animalia ex putrefactione.[1] Nam circa animalia per-

[1] The epithet perfecta is generally given to those animals which cannot result from putrefaction. Cæsalpinus, in the *Quæstiones Peripat.* v. 1.,

fecta et terrestria, per exectiones fœtuum ex utero, minus humanum esset ista inquirere; nisi forte per occasiones abortuum, et venationum, et similium. Omnino igitur vigilia quædam servanda est circa naturam, ut quæ melius se conspiciendam præbeat noctu quam interdiu. Istæ enim contemplationes tanquam nocturnæ censeri possint, ob lucernæ parvitatem et perpetuationem.

Quin et in inanimatis idem tentandum est; id quod nos fecimus in inquirendis aperturis liquorum per ignem.[1] Alius enim est modus aperturæ in aqua, alius in vino, alius in aceto, alius in omphacio;[2] longe alius in lacte, et oleo, et cæteris. Id quod facile cernere erat per ebullitionem super ignem lenem, et in vase vitreo, ubi omnia cerni perspicue possint. Verum hæc brevius perstringimus, fusius et exactius de iis sermones habituri cum ad inventionem *Latentis* rerum *Processus* ventum erit. Semper enim memoria tenendum est, nos hoc loco non res ipsas tractare, sed exempla tantum adducere.

maintains that all animals may result from putrefaction, and that this was the doctrine of Aristotle. The same opinion had, I believe, been advanced by Averrois. That mice may be produced by equivocal generation is asserted, as a matter not admitting of dispute, by Cardan, *De Rerum Varietate*. Cæsalpinus refers to the same instance, but less confidently than Cardan. It is worth remarking that Aristotle, though he speaks of the great fecundity of mice, and even of their being impregnated by licking salt, does not mention the possibility of their being produced by putrefaction. (*De Hist. Animal.* vi. 37. *Problem.* x. 64.) Paracelsus, *De Rerum Generatione*, affirms that all animals produced from putrefaction are more or less venomous. Telesius's opinion is that the more perfect animals cannot result from putrefaction, because the conditions of temperature necessary to their production cannot be fulfilled except by means of animal heat.

[1] "Apertura" means the same thing as "expansio."

[2] Wine made of sour grapes. (*Pliny*, xiv. 18. and elsewhere.) It is probably to be rendered verjuice, as it is by Lemmius.

XLII.

Inter Prærogativas Instantiarum, ponemus loco decimo nono *Instantias Supplementi*, sive *Substitutionis;* quas etiam *Instantias Perfugii* appellare consuevimus. Eæ sunt, quæ supplent informationem ubi sensus plane destituitur; atque idcirco ad eas confugimus cum instantiæ propriæ haberi non possint. Dupliciter autem fit substitutio; aut per Graduationem, aut per Analoga. Exempli gratia; non invenitur medium quod inhibeat prorsus operationem magnetis in movendo ferrum; non aurum interpositum, non argentum, non lapis, non vitrum, lignum, aqua, oleum, pannus aut corpora fibrosa, aër, flamma, et cætera. Attamen per probationem exactam fortasse inveniri possit aliquod medium quod hebetet virtutem ipsius plus quam aliquod aliud, comparative et in aliquo gradu; veluti quod non trahat magnes ferrum per tantam crassitiem auri quam per par spatium aëris; aut per tantum argentum ignitum quam per frigidum; et sic de similibus. Nam de his nos experimentum non fecimus; sed sufficit tamen ut proponantur loco exempli. Similiter non invenitur hic apud nos corpus quod non suscipiat calidum igni approximatum. Attamen longe citius suscipit calorem aër quam lapis. Atque talis est substitutio quæ fit per Gradus.

Substitutio autem per Analoga, utilis sane, sed minus certa est; atque idcirco cum judicio quodam adhibenda. Ea fit cum deducitur non-sensibile ad sensum, non per operationes sensibiles ipsius corporis insensibilis, sed per contemplationem corporis alicujus cognati sensibilis.[1] Exempli gratia; si inquiratur de Mistura

[1] Du Bois Raymond's *Researches in Animal Electricity* give a good ex-

Spirituum, qui sunt corpora non-visibilia, videtur esse cognatio quædam inter corpora et fomites sive alimenta sua. Fomes autem flammæ videtur esse oleum et pinguia; aëris, aqua et aquea: flammæ enim multiplicant se super halitus olei, aër super vapores aquæ. Videndum itaque de mistura aquæ et olei, quæ se manifestat ad sensum; quandoquidem mistura aëris et flammei generis fugiat sensum. At oleum et aqua inter se per compositionem aut agitationem imperfecte admodum miscentur; eadem in herbis, et sanguine, et partibus animalium, accurate et delicate miscentur. Itaque simile quiddam fieri possit circa misturam flammei et aërei generis in spiritalibus; quæ per confusionem simplicem non bene sustinent misturam, eadem tamen in spiritibus plantarum et animalium misceri videntur; præsertim cum omnis spiritus animatus depascat humida utraque, aquea et pinguia, tanquam fomites suos.

Similiter si non de perfectioribus misturis spiritalium, sed de compositione tantum inquiratur; nempe, utrum facile inter se incorporentur, an potius (exempli gratia) sint aliqui venti et exhalationes, aut alia corpora spiritalia, quæ non miscentur cum aëre communi, sed tantum hærent et natant in eo, in globulis et guttis, et potius franguntur ac comminuuntur ab aëre quam in ipsum recipiuntur et incorporantur; hoc in aëre communi et aliis spiritalibus, ob subtilitatem corporum, percipi ad sensum non potest; attamen imago quædam hujus rei, quatenus fiat, concipi possit in liquoribus argenti vivi, olei, aquæ; atque etiam in aëre, et fractione ejus, quando dissipatur et ascendit in parvis portiun-

ample of this. He constructed what may be called an electrical model of a muscle, and succeeded in obtaining an illustration not only of his fundamental result, namely that any transverse section is negative with respect to any longitudinal one, but also of the more complicated relations between two different portions of the same section.

culis per aquam; atque etiam in fumis crassioribus; denique in pulvere excitato et hærente in aëre; in quibus omnibus non fit incorporatio. Atque repræsentatio prædicta in hoc subjecto non mala est, si illud primo diligenter inquisitum fuerit, utrum possit esse talis heterogenia inter spiritalia qualis invenitur inter liquida; nam tum demum hæc simulacra per Analogiam non incommode substituentur.

Atque de Instantiis istis Supplementi, quod diximus informationem ab iis hauriendam esse, quando desint instantiæ propriæ, loco Perfugii; nihilominus intelligi volumus, quod illæ etiam magni sint usus etiam cum propriæ instantiæ adsint; ad roborandam scilicet informationem una cum propriis. Verum de his exactius dicemus quando ad *Adminicula Inductionis* tractanda sermo ordine dilabetur.

XLIII.

Inter Prærogativas Instantiarum, ponemus loco vicesimo *Instantias Persecantes;* quas etiam *Instantias Vellicantes* appellare consuevimus, sed diversa ratione. Vellicantes enim eas appellamus, quia vellicant intellectum; Persecantes, quia persecant naturam; unde etiam illas quandoque *Instantias Democriti* nominamus. Eæ sunt, quæ de admirabili et exquisita subtilitate naturæ intellectum submonent, ut excitetur et expergiscatur ad attentionem et observationem et inquisitionem debitam. Exempli gratia; quod parum guttulæ atramenti ad tot literas vel lineas extendatur; quod argentum, exterius tantum inauratum, ad tantam longitudinem fili inaurati continuetur;[1] quod pusillus

[1] Dr. Woolaston's method for obtaining wires of extreme fineness was perhaps suggested by the circumstance mentioned in the text. He enclosed

vermiculus, qualis in cute invenitur, habeat in se spiritum simul et figuram dissimilarem partium; quod parum croci etiam dolium aquæ colore inficiat; quod parum zibethi [1] aut aromatis longe majus contentum aëris odore; quod exiguo suffitu tanta excitetur nubes fumi; quod sonorum tam accuratæ differentiæ, quales sint voces articulatæ, per aërem undequaque vehantur, atque per foramina et poros etiam ligni et aquæ (licet admodum extenuatæ) penetrent, quin etiam repercutiantur, idque tam distincte et velociter; quod lux et color, etiam tanto ambitu et tam perniciter, per corpora solida vitri, aquæ, et cum tanta et tam exquisita varietate imaginum permeent, etiam refringantur et reflectantur; quod magnes per corpora omnigena, etiam maxime compacta, operetur. Sed (quod magis mirum est) quod in his omnibus, in medio adiaphoro (quale est aër) unius actio aliam non magnopere impediat; nempe quod eodem tempore per spatia aëris devehantur et visibilium tot imagines, et vocis articulatæ tot percussiones, et tot odores specificati, ut violæ, rosæ; etiam calor et frigus et virtutes magneticæ; omnia (inquam) simul, uno alterum non impediente, ac si singula haberent vias et meatus suos proprios separatos, neque unum in alterum impingeret aut incurreret.

Solemus tamen utiliter hujusmodi Instantiis Persecantibus subjungere instantias, quas *Metas Persecationis* appellare consuevimus; veluti quod in iis quæ diximus, una actio in diverso genere aliam non perturbet aut impediat, cum tamen in eodem genere una aliam domet et extinguat: veluti, lux solis, lucem cicindelæ; sonitus bombardæ, vocem; fortior odor, delicatiorem; inten-

a gold wire in a cylinder of silver, drew them out together, and then dissolved away the silver by means of warm nitrous acid.

[1] Civet.

sior calor, remissiorem ; lamina ferri interposita inter magnetem et aliud ferrum, operationem magnetis. Verum de his quoque inter Adminicula Inductionis erit proprius dicendi locus.

XLIV.

Atque de instantiis quæ juvant sensum, jam dictum est ; quæ præcipui usus sunt ad partem Informativam. Informatio enim incipit a sensu. At universum negotium desinit in Opera ; atque quemadmodum illud principium, ita hoc finis rei est. Sequentur itaque instantiæ præcipui usus ad partem Operativam. Eæ genere duæ sunt, numero septem ; quas universas, generali nomine, *Instantias Practicas* appellare consuevimus. Operativæ autem partis, vitia duo ; totidemque dignitates instantiarum in genere. Aut enim fallit operatio, aut onerat nimis. Fallit operatio maxime (præsertim post diligentem naturarum inquisitionem) propter male determinatas et mensuratas corporum vires et actiones. Vires autem et actiones, corporum circumscribuntur et mensurantur, aut per spatia loci, aut per momenta temporis, aut per unionem quanti, aut per prædominantiam virtutis ; quæ quatuor nisi fuerint probe et diligenter pensitata, erunt fortasse scientiæ speculatione quidem pulchræ, sed opere inactivæ. Instantias vero quatuor itidem quæ huc referuntur, uno nomine *Instantias Mathematicas* vocamus, et *Instantias Mensuræ.*

Onerosa autem fit praxis, vel propter misturam rerum inutilium, vel propter multiplicationem instrumentorum, vel propter molem materiæ et corporum quæ ad aliquod opus requiri contigerint. Itaque eæ instantiæ in pretio esse debent, quæ aut dirigunt operativam ad

ea quæ maxime hominum intersunt; aut quæ parcunt instrumentis; aut quæ parcunt materiæ sive supellectili. Eas autem tres instantias quæ huc pertinent, uno nomine *Instantias Propitias* sive *Benevolas* vocamus. Itaque de his septem instantiis jam sigillatim dicemus; atque cum iis partem illam de Prærogativis sive Dignitatibus Instantiarum claudemus.

XLV.

Inter Prærogativas Instantiarum, ponemus loco vicesimo primo *Instantias Virgæ*, sive *Radii;* quas etiam *Instantias Perlationis*, vel *de Non Ultra* appellare consuevimus. Virtutes enim rerum et motus operantur et expediuntur per spatia non indefinita aut fortuita, sed finita et certa; quæ ut in singulis naturis inquisitis teneantur et notentur plurimum interest Practicæ, non solum ad hoc, ut non fallat, sed etiam ut magis sit aucta et potens. Etenim interdum datur virtutes producere, et distantias tanquam retrahere in propius; ut in perspecillis.

Atque plurimæ virtutes operantur et afficiunt tantum per tactum manifestum; ut fit in percussione corporum, ubi alterum non summovet alterum, nisi impellens impulsum tangat. Etiam medicinæ quæ exterius applicantur, ut unguenta, emplastra, non exercent vires suas nisi per tactum corporis. Denique objecta sensuum tactus et gustus non feriunt nisi contigua organis.

Sunt et aliæ virtutes quæ operantur ad distantiam, verum valde exiguam, quarum paucæ adhuc notatæ sunt, cum tamen plures sint quam homines suspicentur; ut (capiendo exempla ex vulgatis) cum succinum[1] aut gagates[2] trahunt paleas; bullæ approximatæ sol-

[1] Amber. [2] Jet.

vunt bullas; medicinæ nonnullæ purgativæ eliciunt humores ex alto,[1] et hujusmodi. At virtus illa magnetica per quam ferrum et magnes, vel magnetes invicem, coëunt, operatur intra orbem virtutis certum, sed parvum; ubi contra, si sit aliqua virtus magnetica emanans ab ipsa terra (paulo nimirum interiore) super acum ferream, quatenus ad verticitatem, operatio fiat ad distantiam magnam.

Rursus, si sit aliqua vis magnetica quæ operetur per consensum inter globum terræ et ponderosa, aut inter globum lunæ et aquas maris (quæ maxime credibilis videtur in fluxibus et refluxibus semi-menstruis[2]), aut inter cœlum stellatum et planetas, per quam evocentur et attollantur ad sua apogæa; hæc omnia operantur ad distantias admodum longinquas. Inveniuntur et quædam inflammationes sive conceptiones flammæ, quæ fiunt ad distantias bene magnas, in aliquibus materiis; ut referunt de naphtha Babylonica.[3] Calores etiam insinuant se per distantias amplas, quod etiam faciunt frigora; adeo ut habitantibus circa Canadam moles sive massæ

[1] Bacon here speaks in accordance with the medical theory in which the brain is the origin and seat of the rheum, which descends from thence and produces disease in other organs — a theory preserved in the word catarrh. Certain purgatives were supposed to draw the rheum down.

[2] It is worth remarking that Galileo speaks contemptuously of the notion that the moon exerts any influence on the tides. His strong wish to explain everything mechanically led him in this instance wrong, as a similar wish has led many others. It arose, not unnaturally, from a reaction against the unsatisfactory explanations which the schoolmen were in the habit of deducing from the specific or occult properties of bodies. Even Leibnitz, in his controversy with Clarke, shows a tendency towards an exclusive preference of a mechanical system of physics, though in other parts of his writings he had spoken favourably of the doctrine of attraction, and though his whole philosophy ought, one would think, to have made him indifferent to the point in dispute. In a system of pre-established harmony, action by contact is as merely apparent as action at a distance.

[3] Strabo, xvi. p. 742. Pliny, ii. § 109.

glaciales, quæ abrumpuntur et natant per oceanum septentrionalem et deferuntur per Atlanticum versus illas oras, percipiantur et incutiant frigora e longinquo. Odores quoque (licet in his videatur semper esse quædam emissio corporea) operantur ad distantias notabiles; ut evenire solet navigantibus juxta litora Floridæ, aut etiam nonnulla Hispaniæ, ubi sunt sylvæ totæ ex arboribus limonum, arantiorum,[1] et hujusmodi plantarum odoratarum, aut frutices rorismarini, majoranæ, et similium.[2] Postremo radiationes lucis et impressiones sonorum operantur scilicet ad distantias spatiosas.

Verum hæc omnia, utcunque operentur ad distantias parvas sive magnas, operantur certe ad finitas et naturæ notas,[4] ut sit quiddam *Non Ultra;* idque pro rationibus, aut molis seu quanti corporum; aut vigoris et debilitatis virtutum; aut favoribus et impedimentis mediorum; quæ omnia in computationem venire et notari debent. Quinetiam mensuræ motuum violentorum (quos vocant), ut missilium, tormentorum, rotarum, et similium, cum hæ quoque manifesto suos habeant limites certos, notandæ sunt.

Inveniuntur etiam quidam motus et virtutes contrariæ illis quæ operantur per tactum et non ad distans; quæ operantur scilicet ad distans et non ad tactum; et rursus, quæ operantur remissius ad distantiam minorem et fortius ad distantiam majorem. Etenim visio non bene transigitur ad tactum, sed indiget medio et distantia. Licet meminerim me audisse ex relatione cujusdam fide digni, quod ipse in curandis oculorum

[1] [So in the original edition.] Qy. aurantiorum?

[2] To the same purpose Milton, *Paradise Lost*, iv. 99.:—

As when to them who sail
Beyond the Cape of Hope, &c.

[3] *i. e.* fixed in the nature of things.

suorum cataractis (erat autem cura talis, ut immitteretur festuca quædam parva argentea intra primam oculi tunicam, quæ pelliculam illam cataractæ removeret et truderet in angulum oculi) clarissime vidisset festucam illam supra ipsam pupillam moventem. Quod utcunque verum esse possit, manifestum est majora corpora non bene aut distincte cerni nisi in cuspide coni,[1] coëuntibus radiis objecti ad nonnullam distantiam. Quin etiam in senibus oculus melius cernit remoto objecto paulo longius, quam propius. In missilibus autem certum est percussionem non fieri tam fortem ad distantiam nimis parvam, quam paulo post. Hæc itaque et similia in mensuris motuum quoad distantias notanda sunt.

Est et aliud genus mensuræ localis motuum, quod non prætermittendum est. Illud vero pertinet ad motus non progressivos, sed sphæricos; hoc est, ad expansionem corporum in majorem sphæram, aut contractionem in minorem. Inquirendum enim est inter mensuras istas motuum, quantam compressionem aut extensionem corpora (pro natura ipsorum) facile et libenter patiantur, et ad quem terminum reluctari incipiant, adeo ut ad extremum *Non Ultra* ferant; ut cum vesica inflata comprimitur, sustinet illa compressionem nonnullam aëris, sed si major fuerit, non patitur aër, sed rumpitur vesica.

At nos hoc ipsum subtiliore experimento magis exacte probavimus. Accepimus enim campanulam ex metallo, leviorem scilicet et tenuiorem, quali ad excipiendum salem utimur; eamque in pelvim aquæ immisimus, ita ut deportaret secum aërem qui continebatur in concavo usque ad fundum pelvis. Locaveramus autem

[1] That is, the eye being at the apex of the visual cone.

prius globulum in fundo pelvis, super quem campanula imponenda esset. Quare illud eveniebat, ut si globulus ille esset minusculus (pro ratione concavi), reciperet se aër in locum minorem, et contruderetur solum, non extruderetur. Quod si grandioris esset magnitudinis quam ut aër libenter cederet, tum aër majoris pressuræ impatiens campanulam ex aliqua parte elevabat, et in bullis ascendebat.

Etiam ad probandum qualem extensionem (non minus quam compressionem) pateretur aër, tale quippiam practicavimus. Ovum vitreum accepimus, cum parvo foramine in uno extremo ovi. Aërem per foramen exuctione forti attraximus, et statim digito foramen illud obturavimus, et ovum in aquam immersimus, et dein digitum removimus. Aër vero tensura illa per exuctionem facta tortus et magis quam pro natura sua dilatatus, ideoque se recipere et contrahere nitens (ita ut si ovum illud in aquam non fuisset immersum, aërem ipsum traxisset cum sibilo), aquam traxit ad tale quantum quale sufficere posset ad hoc, ut aër antiquam recuperaret sphæram sive dimensionem.[1]

Atque certum est corpora tenuiora (quale est aër) pati contractionem nonnullam. notabilem, ut dictum est ; at corpora tangibilia (quale est aqua) multo ægrius et ad minus spatium patiuntur compressionem. Qualem autem patiatur, tali experimento inquisivimus.

Fieri fecimus globum ex plumbo cavum, qui duas circiter pintas vinarias contineret ; eumque satis per

[1] This explanation is wholly unsatisfactory. The principle upon which the true explanation depends, namely the pressure of the atmosphere, was, it seems tolerably certain, first suggested by Torricelli. If the experiment were performed in vacuo, no water would enter the egg, unless the egg were plunged to a considerable depth into the water, or unless the vacuum within it were more perfect than could be produced in the manner described.

latera crassum, ut majorem vim sustineret. In illum aquam immisimus, per foramen alicubi factum; atque foramen illud, postquam globus aqua impletus fuisset, plumbo liquefacto obturavimus, ut globus deveniret plane consolidatus. Dein globum forti malleo ad duo latera adversa complanavimus; ex quo necesse fuit aquam in minus contrahi, cum sphæra figurarum sit capacissima. Deinde, cum malleatio non amplius sufficeret, ægrius se recipiente aqua, molendino[1] seu torculari usi sumus; ut tandem aqua, impatiens pressuræ ulterioris, per solida plumbi (instar roris delicati) exstillaret. Postea, quantum spatii per eam compressionem imminutum foret computavimus; atque tantam compressionem passam esse aquam (sed violentia magna subactam) intelleximus.[2]

[1] Molendinum is properly a Low Latin word for a mill-house; here used for a press.

[2] This is perhaps the most remarkable of Bacon's experiments; and it is singular that it was so little spoken of by subsequent writers. Nearly fifty years after the publication of the *Novum Organum*, an account of a similar experiment was published by Megalotti, who was secretary of the Accademia del Cimento at Florence; and it has since been familiarly known as the Florentine experiment. I quote his account of it. "Facemmo lavorar di getto una grande ma sottil palla d' argento, e quella ripiena d' acqua raffreddata col ghiaccio serramo con saldissime vite. Di poi cominciammo a martellarla leggiermente per ogni verso, onde ammaccato l' argento (il quale per la sua crudezza non comporta d' assottigliarsi e distendersi come farebbe l' oro raffinato, o il piombo, o altro metallo più dolce) veniva a ristrignersi, e scemare la sua interna capacità, senza che l' acqua patisse una minima compressione, poichè ad ogni colpo si videa trasudare per tutti i pori del metallo a guisa d' argento vivo il quale da alcuna pelle premuto minutamente sprizzasse." — *Saggi di naturali Esperienze fatte nell' Accademia del Cimento*, p. 204. Firenze, 1667. The writer goes on to remark that the absolute incompressibility of water is not proved by this experiment, but merely that it is not to be compressed in the manner described. But the experiment is on other grounds inconclusive.

It is to be remarked that Leibnitz, *Nouveaux Essais*, in mentioning the Florentine experiment, says that the globe was of gold (p. 229. Erdmann), whereas the Florentine academicians expressly say why they preferred silver to either gold or lead.

At solidiora, sicca, aut magis compacta, qualia sunt lapides et ligna, nec non metalla, multo adhuc minorem compressionem aut extensionem, et fere imperceptibilem ferunt; sed vel fractione, vel progressione, vel aliis pertentationibus se liberant; ut in curvationibus ligni aut metalli, horologiis moventibus per complicationem laminæ, missilibus, malleationibus, et innumeris aliis motibus apparet. Atque hæc omnia cum mensuris suis in indagatione naturæ notanda et exploranda sunt, aut in certitudine sua, aut per æstimativas, aut per comparativas, prout dabitur copia.

XLVI.

Inter Prærogativas Instantiarum, ponemus loco vicesimo secundo *Instantias Curriculi*, quas etiam *Instantias ad Aquam* appellare consuevimus; sumpto vocabulo a clepsydris apud antiquos, in quas infundebatur aqua, loco arenæ. Eæ mensurant naturam per momenta temporis, quemadmodum *Instantiæ Virgæ* per gradus spatii. Omnis enim motus sive actio naturalis transigitur in tempore; alius velocius, alius tardius, sed utcunque momentis certis et naturæ notis. Etiam illæ actiones quæ subito videntur operari, et in ictu oculi (ut loquimur), deprehenduntur recipere majus et minus quoad tempus.

Primo itaque videmus restitutiones corporum cœlestium fieri per tempora numerata; etiam fluxus et refluxus maris. Latio autem gravium versus terram et levium versus ambitum cœli, fit per certa momenta, pro ratione corporis quod fertur, et medii.[1] At velifi-

[1] Galileo had shown, before the year 1592, that the resistance of the air being set aside, all bodies fall with equal velocity. He left Pisa in that year in consequence of the disputes which were occasioned by this refutation of the Aristotelian doctrine, that the velocity is as the weight.

cationes navium, motus animalium, perlationes missilium, omnes fiunt itidem per tempora (quantum ad summas) numerabilia. Calorem vero quod attinet, videmus pueros per hyemem manus in flamma lavare, nec tamen uri; et joculatores vasa plena vino vel aqua, per motus agiles et æquales, vertere deorsum et sursum recuperare, non effuso liquore; et multa hujusmodi. Nec minus ipsæ compressiones et dilatationes et eruptiones corporum fiunt, aliæ velocius, aliæ tardius, pro natura corporis et motus, sed per momenta certa. Quinetiam in explosione plurium bombardarum simul, quæ exaudiuntur quandoque ad distantiam triginta milliarium, percipitur sonus prius ab iis qui prope absunt a loco ubi fit sonitus, quam ab iis qui longe. At in visu (cujus actio est pernicissima) liquet etiam requiri ad eum actuandum momenta certa temporis; idque probatur ex iis quæ propter motus velocitatem non cernuntur; ut ex latione pilæ ex sclopeto. Velocior enim est prætervolatio pilæ quam impressio speciei ejus quæ deferri poterat ad visum.[1]

Atque hoc, cum similibus, nobis quandoque dubitationem peperit plane monstrosam; videlicet, utrum cœli sereni et stellati facies ad idem tempus cernatur quando vere existit, an potius aliquanto post; et utrum non sit (quatenus ad visum cœlestium) non minus tempus verum et tempus visum, quam locus verus et locus visus, qui notatur ab astronomis in parallaxibus.[2] Adeo incredibile nobis videbatur, species sive radios corporum cœlestium per tam immensa spatia milliarium subito deferri posse ad visum; sed

[1] *i. e.* the ball flies past in less time than the image conveyed to the sight requires to make an impression.

[2] *i. e.* which is taken account of in the correction for parallaxes.

potius debere eas in tempore aliquo notabili delabi. Verum illa dubitatio (quoad majus aliquod intervallum temporis inter tempus verum et visum) postea plane evanuit; reputantibus nobis jacturam illam infinitam et diminutionem quanti, quatenus ad apparentiam, inter corpus stellæ verum et speciem visam, quæ causatur a distantia; atque simul notantibus ad quantam distantiam (sexaginta scilicet ad minimum milliariorum) corpora, eaque tantum albicantia, subito hic apud nos cernantur; cum dubium non sit lucem cœlestium, non tantum albedinis vividum colorem, verum etiam omnis flammæ (quæ apud nos nota est) lucem, quoad vigorem radiationis, multis partibus excedere. Etiam immensa illa velocitas in ipso corpore, quæ cernitur in motu diurno (quæ etiam viros graves ita obstupefecit ut mallent credere motum terræ), facit motum illum ejaculationis radiorum ab ipsis (licet celeritate, ut diximus, mirabilem) magis credibilem. Maxime vero omnium nos movit, quod si interponeretur intervallum temporis aliquod notabile inter veritatem et visum, foret ut species per nubes interim orientes et similes medii perturbationes interciperentur sæpenumero, et confunderentur.[1] Atque de mensuris temporum simplicibus hæc dicta sint.

[1] I do not know how to understand this passage without attributing to Bacon a confusion of ideas which seems hardly credible. For surely the very thing which he supposes *would* happen if there were a perceptible interval between the *veritas* and the *visus*, that is to say, between the time when a star (for instance) *is* at a given point and the time when we see it there, — in other words, if the image took any time in coming to the eye, — this very thing does actually happen as often as the star is hidden by a cloud or dimmed by a vapour: the species, to use his own word, are intercepted or confused. If, indeed, the *force* of the rays were diminished, — and this I suppose would be one consequence of diminished velocity, — the thing would happen more frequently, because there would be more obstructions which they could not overcome: they would be intercepted or confused by

Verum non solum quærenda est mensura motuum et actionum simpliciter, sed multo magis comparative: id enim eximii est usus, et ad plurima spectat. Atque videmus flammam alicujus tormenti ignei citius cerni, quam sonitus audiatur; licet necesse sit pilam prius aërem percutere, quam flamma quæ pone erat exire potuerit; fieri hoc autem propter velociorem transactionem motus lucis, quam soni. Videmus etiam species visibiles a visu citius excipi quam dimitti; unde fit quod nervi fidium, digito impulsi, duplicentur aut triplicentur quoad speciem, quia species nova recipitur, antequam prior demittatur; ex quo etiam fit, ut annuli rotati videantur globosi, et fax ardens, noctu velociter portata, conspiciatur caudata.[1] Etiam ex hoc fundamento inæqualitatis motuum quoad velocitatem, excogitavit Galilæus causam fluxus et refluxus maris; rotante terra velocius, aquis tardius; ideoque accumulantibus se aquis in sursum, et deinde per vices se remittentibus in deorsum, ut demonstratur in vase aquæ incitatius movente.[2] Sed hoc commentus

media which they now pass through. But the force being the same, and the stream continuous, the *time* of passage could make no difference in this respect. In another respect, namely the facility of observation, it would make a very great difference; and it is remarked by Brinkley that, if the velocity of light had been much less than it is, astronomy would have been all but an impossible science. But that is another matter. — *J. S.*

[1] Of the phenomena which he here enumerates Bacon undoubtedly gives the right explanation, though in the case of vibrating strings his explanation is not altogether complete. The distinct or quasi-distinct images to which he refers correspond to limiting positions of the vibrating string.

[2] This account of Galileo's theory of the tides is inaccurate. In this theory the tides are caused by the varying velocity of different points of the earth's surface, arising from the composition of the earth's two motions, namely that about its axis, and that in its orbit. Bacon does not seem to have perceived that both these motions are essential to the explanation. That the earth's being in motion might be the cause of the tides, had been suggested before the time of Galileo by Cæsalpinus in the *Quæstiones Peripateticæ*, iii. 5. It is odd that Patritius, in giving an account of all the

est concesso non concessibili (quod terra nempe moveatur), ac etiam non bene informatus de oceani motu sexhorario.

At exemplum hujus rei de qua agitur, videlicet de comparativis mensuris motuum, neque solum rei ipsius, sed et usus insignis ejus (de quo paulo ante loquuti sumus), eminet in cuniculis subterraneis, in quibus collocatur pulvis pyrius; ubi immensæ moles terræ, ædificiorum, et similium, subvertuntur, et in altum jaciuntur, a pusilla quantitate pulveris pyrii. Cujus causa pro certo illa est, quod motus dilatationis pulveris, qui impellit, multis partibus sit pernicior, quam motus gravitatis per quem fieri possit aliqua resistentia; adeo ut primus motus perfunctus sit, antequam motus adversus inceperit; ut in principiis nullitas quædam sit resistentiæ. Hinc etiam fit, quod in omni missili, ictus, non tam robustus quam acutus et celer, ad perlationem potissimum valeat. Neque etiam fieri potuisset, ut parva quantitas spiritus animalis in animalibus, præsertim in tam vastis corporibus qualia sunt balænæ aut elephanti, tantam molem corpoream flecteret et regeret, nisi propter velocitatem motus spiritus, et hebetudinem corporeæ molis, quatenus ad expediendam suam resistentiam.

Denique, hoc unum ex præcipuis fundamentis est experimentorum magicorum, de quibus mox dicemus; ubi scilicet parva moles materiæ longe majorem superat et in ordinem redigit: hoc, inquam, si fieri

theories which had in his time been devised to explain the cause of the tides (see his *Pancosmia*, l. 28.), does not mention Cæsalpinus's, though it was published some years before his own work. Galileo perhaps alludes to Cæsalpinus in his letter to Cardinal Orsino, dated 8th January, 1616. See, for remarks on Cæsalpinus's doctrine, the *Problemata Marina* of Casmann, published in 1596. Casmann's own theory is that of expansion.

possit anteversio motuum per velocitatem unius, antequam alter se expediat.

Postremo, hoc ipsum *Prius* et *Posterius* in omni actione naturali notari debet; veluti quod in infusione rhabarbari eliciatur purgativa vis prius, astrictiva post; simile quiddam etiam in infusione violarum in acetum experti sumus; ubi primo excipitur suavis et delicatus floris odor; post, pars floris magis terrea, quæ odorem confundit. Itaque si infundantur violæ per diem integrum, odor multo languidius excipitur; quod si infundantur per partem quartam horæ tantum, et extrahantur; et (quia paucus est spiritus odoratus qui subsistit in viola) infundantur post singulas quartas horæ violæ novæ et recentes ad sexies; tum demum nobilitatur infusio, ita ut licet non manserint violæ, utcunque renovatæ, plus quam ad sesquihoram, tamen permanserit odor gratissimus, et viola ipsa non inferior, ad annum integrum. Notandum tamen est, quod non se colligat odor ad vires suas plenas, nisi post mensem ab infusione. In distillationibus vero aromatum maceratorum in spiritu vini patet quod surgat primo phlegma aqueum et inutile, deinde aqua plus habens ex spiritu vini, deinde post aqua plus habens ex aromate. Atque hujus generis quamplurima inveniuntur in distillationibus notatu digna. Verum hæc sufficiant ad exempla.

XLVII.

Inter Prærogativas Instantiarum, ponemus loco vicesimo tertio *Instantias Quanti*, quas etiam *Doses Naturæ* (sumpto vocabulo a Medicinis) vocare consuevimus. Eæ sunt quæ mensurant virtutes per *Quanta* corporum, et indicant quid *Quantum Corporis* faciat ad *Modum Virtutis*. Ac primo sunt quædam virtutes quæ non

subsistunt nisi in Quanto Cosmico, hoc est, tali Quanto quod habeat consensum cum configuratione et fabrica universi. Terra enim stat; partes ejus cadunt. Aquæ in maribus fluunt et refluunt; in fluviis minime, nisi per ingressum maris. Deinde etiam omnes fere virtutes particulares secundum multum aut parvum corporis operantur. Aquæ largæ non facile corrumpuntur; exiguæ cito. Mustum et cervisia maturescunt longe citius, et fiunt potabilia, in utribus parvis, quam in doliis magnis. Si herba ponatur in majore portione liquoris, fit infusio, magis quam imbibitio;[1] si in minore, fit imbibitio, magis quam infusio. Aliud igitur erga corpus humanum est balneum, aliud levis irroratio. Etiam parvi rores in aëre nunquam cadunt, sed dissipantur et cum aëre incorporantur. Et videre est in anhelitu super gemmas, parum illud humoris, quasi nubeculam vento dissipatam, continuo solvi. Etiam frustum ejusdem magnetis non trahit tantum ferri, quantum magnes integer. Sunt etiam virtutes in quibus parvitas Quanti magis potest; ut in penetrationibus, stylus acutus citius penetrat, quam obtusus; adamas punctuatus sculpit in vitro; et similia.

Verum non hic morandum est in indefinitis, sed etiam de *rationibus* Quanti corporis erga modum virtutis inquirendum. Proclive enim foret credere, quod rationes Quanti rationes virtutis adæquarent; ut si pila plumbea unius unciæ caderet in tali tempore, pila unciarum duarum deberet cadere duplo celerius, quod falsissimum est. Nec eædem rationes in omni genere virtutum valent, sed longe diversæ. Itaque hæ mensuræ ex rebus ipsis petendæ sunt, et non ex verisimilitudine aut conjecturis.

[1] Absorption.

Denique in omni inquisitione naturæ Quantum corporis requiratur ad aliquod effectum, tanquam dosis, notandum; et cautiones de *Nimis* et *Parum* aspergendæ.

XLVIII.

Inter Prærogativas Instantiarum, ponemus loco vicesimo quarto *Instantias Luctæ;* quas etiam *Instantias Prædominantiæ* appellare consuevimus. Eæ indicant prædominantiam et cessionem virtutum ad invicem; et quæ ex illis sit fortior et vincat, quæ infirmior et succumbat. Sunt enim motus et nixus corporum compositi, decompositi, et complicati, non minus quam corpora ipsa. Proponemus igitur primum species præcipuas motuum sive virtutum activarum; ut magis perspicua sit ipsarum comparatio in robore, et exinde demonstratio atque designatio Instantiarum Luctæ et Prædominantiæ.

Motus Primus sit Motus *Antitypiæ*[1] materiæ, quæ inest in singulis portionibus ejus; per quem plane annihilari non vult: ita ut nullum incendium, nullum pondus aut depressio, nulla violentia, nulla denique ætas aut diuturnitas temporis possit redigere aliquam vel minimam portionem materiæ in nihilum; quin illa et sit aliquid, et loci aliquid occupet, et se (in qualicunque necessitate ponatur) vel formam mutando vel locum liberet, vel (si non detur copia) ut est subsistat; neque unquam res eo deveniat, ut aut nihil sit, aut nullibi. Quem Motum Schola (quæ semper fere et denominat et definit res potius per effectus et incommoda quam per causas interiores) vel denotat per illud axioma, quod *Duo corpora non possint esse in uno loco;* vel vocat motum *Ne fiat penetratio dimensionum.* Neque hujus motus ex-

[1] This term was first used by Aristotle.

empla proponi consentaneum est: inest enim omni corpori.

Sit Motus Secundus, Motus (quem appellamus) *Nexus;* per quem corpora non patiuntur se ulla ex parte sui dirimi a contactu alterius corporis, ut quæ mutuo nexu et contactu gaudeant. Quem motum Schola vocat Motum *Ne detur vacuum:* veluti cum aqua attrahitur sursum exuctione, aut per fistulas; caro per ventosas; aut cum aqua sistitur nec effluit in hydriis perforatis, nisi os hydriæ ad immittendum aërem aperiatur; et innumera id genus.

Sit Motus Tertius, Motus (quem appellamus) *Libertatis;* per quem corpora se liberare nituntur a pressura aut tensura præter-naturali, et restituere se in dimensum corpori suo conveniens. Cujus motus etiam innumera sunt exempla: veluti (quatenus ad liberationem a pressura) aquæ in natando, aëris in volando; aquæ in remigando, aëris in undulationibus ventorum; laminæ in horologiis. Nec ineleganter se ostendit motus aëris compressi in sclopettis ludicris puerorum, cum alnum aut simile quiddam excavant, et infarciunt frusto alicujus radicis succulentæ, vel similium, ad utrosque fines; deinde per embolum[1] trudunt radicem vel hujusmodi farcimentum in foramen alterum; unde emittitur et ejicitur radix cum sonitu ad foramen alterum, idque antequam tangatur a radice aut farcimento citimo, aut embolo. Quatenus vero ad liberationem a tensura, ostendit se hic motus in aëre post exuctionem in ovis vitreis remanente; in chordis, in corio, et panno; resilientibus post tensuras suas, nisi tensuræ illæ per moram invaluerint, etc. Atque hunc motum Schola sub nomine Motus ex *Forma Elementi* innuit:

[1] Ἔμβολος, anything introduced [a ramrod?].

satis quidem inscite, cum hic motus non tantum ad aërem, aquam, aut flammam pertineat, sed ad omnem diversitatem consistentiæ; ut ligni, ferri, plumbi, panni, membranæ, etc., in quibus singula corpora suæ habent dimensionis modulum, et ab eo ægre ad spatium aliquod notabile abripiuntur. Verum quia Motus iste Libertatis omnium est maxime obvius, et ad infinita spectans, consultum fuerit eum bene et perspicue distinguere. Quidam enim valde negligenter confundunt hunc motum cum gemino illo motu *Antitypiæ* et *Nexus;* liberationem scilicet a pressura, cum motu Antitypiæ; a tensura, cum motu Nexus; ac si ideo cederent aut se dilatarent corpora compressa, ne sequeretur *penetratio dimensionum;* ideo resilirent et contraherent se corpora tensa, ne sequeretur *vacuum.* Atqui si aër compressus se vellet recipere in densitatem aquæ, aut lignum in densitatem lapidis, nil opus foret penetratione dimensionum; et nihilominus longe major posset esse compressio illorum, quam illa ullo modo patiuntur. Eodem modo si aqua se dilatare vellet in raritatem aëris, aut lapis in raritatem ligni, non opus foret vacuo; et tamen longe major posset fieri extensio eorum, quam illa ullo modo patiuntur. Itaque non reducitur res ad penetrationem dimensionum et vacuum, nisi in ultimitatibus condensationis et rarefactionis; cum tamen isti motus longe citra eas sistant et versentur, neque aliud sint quam desideria corporum conservandi se in consistentiis suis (sive, si malint, in formis suis), nec ab iis recedendi subito, nisi per modos suaves ac per consensum alterentur. At longe magis necessarium est (quia multa secum trahit), ut intimetur hominibus, motum violentum (quem nos *Mechanicum*, Democritus, qui in motibus suis primis expediendis etiam infra

mediocres philosophos ponendus est, motum *Plagæ* vocavit) nil aliud esse quam Motum Libertatis, scilicet a compressione ad relaxationem. Etenim in omni sive simplici protrusione sive volatu per aërem, non fit summotio aut latio localis, antequam partes corporis præter-naturaliter patiantur et comprimantur ab impellente. Tum vero partibus aliis alias per successionem trudentibus, fertur totum; nec solum progrediendo, sed etiam rotando simul; ut etiam hoc modo partes se liberare, aut magis ex æquo tolerare possint. Atque de hoc Motu hactenus.

Sit Motus Quartus, motus cui nomen dedimus Motus *Hyles:* qui motus antistrophus est quodammodo Motui, de quo diximus, Libertatis. Etenim in Motu Libertatis, corpora novum dimensum sive novam sphæram sive novam dilatationem aut contractionem (hæc enim verborum varietas idem innuit) exhorrent, respuunt, fugiunt, et resilire ac veterem consistentiam recuperare totis viribus contendunt. At contra in hoc Motu Hyles, corpora novam sphæram sive dimensum appetunt; atque ad illud libenter et propere, et quandoque valentissimo nixu (ut in pulvere pyrio) aspirant. Instrumenta autem hujus motus, non sola certe, sed potentissima, aut saltem frequentissima, sunt calor et frigus. Exempli gratia: aër, si per tensuram (velut per exuctionem in ovis vitreis) dilatetur, magno laboret desiderio seipsum restituendi. At admoto calore, e contra appetit dilatari, et concupiscit[1] novam sphæram, et transit et migrat in illam libenter tanquam in novam formam (ut loquuntur); nec post dilatationem nonnullam de reditu curat, nisi per admotionem frigidi ad eam invitetur; quæ non reditus est, sed transmu-

[1] *Concupiscet*, in the original. — *J. S.*

tatio repetita. Eodem modo et aqua, si per compressionem arctetur, recalcitrat; et vult fieri qualis fuit, scilicet latior. At si interveniat frigus intensum et continuatum, mutat se sponte sua et libenter in condensationem glaciei; atque si plane continuetur frigus, nec a teporibus interrumpatur (ut fit in speluncis et cavernis paulo profundioribus), vertitur in crystallum [1] aut materiam similem, nec unquam restituitur.

Sit Motus Quintus, Motus *Continuationis*. Intelligimus autem non continuationis simplicis et primariæ, cum corpore aliquo altero (nam ille est Motus Nexus); sed continuationis sui, in corpore certo. Certissimum enim est, quod corpora omnia solutionem continuitatis exhorreant; alia magis, alia minus, sed omnia aliquatenus. Nam ut in corporibus duris (veluti chalybis, vitri) reluctatio contra discontinuationem est maxime robusta et valida, ita etiam in liquoribus, ubi cessare aut languere saltem videtur motus ejusmodi, tamen non prorsus reperitur privatio ejus; sed plane inest ipsis in gradu tanquam infimo, et prodit se in experimentis plurimis; sicut in bullis, in rotunditate guttarum, in filis tenuioribus stillicidiorum, et in sequacitate corporum glutinosorum, et ejusmodi. Sed maxime omnium se ostendit appetitus iste, si discontinuatio tentetur usque ad fractiones minores. Nam in mortariis, post contusionem ad certum gradum, non am-

[1] Pliny, xxxvii. 9. Also Seneca, *Natural Questions*. Though this account of the origin of crystals is of course erroneous, yet there is a class of crystals which have been shown to occupy the volume which their water of crystallisation would in the state of ice; so that their other constituents may in some sort be said to take up no space. This curious analogy with ice was proved by Playfair and Joule in a very considerable number of cases. See *Phil. Mag.* Dec. 1845.

plius operatur pistillum; aqua non subintrat rimas minores; quin et ipse aër, non obstante subtilitate corporis ipsius, poros vasorum paulo solidiorum non pertransit subito, nec nisi per diuturnam insinuationem.

Sit Motus Sextus, motus quem nominamus Motum *ad Lucrum*, sive Motum *Indigentiæ*. Is est, per quem corpora, quando versantur inter plane heterogenea et quasi inimica, si forte nanciscantur copiam aut commoditatem evitandi illa heterogenea et se applicandi ad magis cognata, (licet illa ipsa cognata talia fuerint quæ non habeant arctum consensum cum ipsis) tamen statim ea amplectuntur, et tanquam potiora malunt; et lucri loco (unde vocabulum sumpsimus) hoc ponere videntur, tanquam talium corporum indiga. Exempli gratia: aurum, aut aliud metallum foliatum non delectatur aëre circumfuso. Itaque si corpus aliquod tangibile et crassum nanciscatur (ut digitum, papyrum, quidvis aliud), adhæret statim, nec facile divellitur. Etiam papyrus, aut pannus, et hujusmodi, non bene se habent cum aëre qui inseritur et commistus est in ipsorum poris. Itaque aquam aut liquorem libenter imbibunt, et aërem exterminant. Etiam saccharum, aut spongia infusa in aquam aut vinum, licet pars ipsorum emineat et longe attollatur supra vinum aut aquam, tamen aquam aut vinum paulatim et per gradus attrahunt in sursum.

Unde optimus canon sumitur aperturæ et solutionum corporum. Missis enim corrosivis et aquis fortibus, quæ viam sibi aperiunt, si possit inveniri corpus proportionatum et magis consentiens et amicum corpori alicui solido quam illud cum quo tanquam per necessitatem commiscetur, statim se aperit et relaxat cor-

pus, et illud alterum intro recipit, priore excluso aut summoto. Neque operatur aut potest iste Motus ad Lucrum solummodo ad tactum. Nam electrica operatio (de qua Gilbertus et alii post eum tantas excitarunt fabulas) non alia est quam corporis per fricationem levem excitati appetitus; qui aërem non bene tolerat, sed aliud tangibile mavult, si reperiatur in propinquo.

Sit Motus Septimus, Motus (quem appellamus) *Congregationis Majoris;* per quem corpora feruntur ad massas connaturalium suorum: gravia, ad globum terræ; levia, ad ambitum cœli. Hunc Schola nomine *Motus Naturalis* insignivit: levi contemplatione, quia scilicet nil spectabile erat ab extra quod eum motum cieret; (itaque rebus ipsis innatum atque insitum putavit); aut forte quia non cessat. Nec mirum: semper enim præsto sunt cœlum et terra; cum e contra causæ et origines plurimorum ex reliquis motibus interdum absint, interdum adsint. Itaque hunc, quia non intermittit sed cæteris intermittentibus statim occurrit, perpetuum et proprium; reliquos ascititios posuit. Est autem iste motus revera satis infirmus et hebes, tanquam is qui (nisi sit moles corporis major) cæteris motibus, quamdiu operantur, cedat et succumbat. Atque cum hic motus hominum cogitationes ita impleverit ut fere reliquos motus occultaverit, tamen parum est quod homines de eo sciunt, sed in multis circa illum errori bus versantur.

Sit Motus Octavus, Motus *Congregationis Minoris;* per quem partes homogeneæ in corpore aliquo separant se ab heterogeneis, et coëunt inter sese; per quem etiam corpora integra ex similitudine substantiæ se amplectuntur et fovent, et quandoque ad distantiam

aliquam congregantur, attrahuntur, et conveniunt: veluti cum in lacte flos lactis post moram aliquam supernatat; in vino fæces et tartarum subsidunt. Neque enim hæc fiunt per motum gravitatis et levitatis tantum, ut aliæ partes summitatem petant, aliæ ad imum vergant; sed multo magis per desiderium homogeneorum inter se coeundi et se uniendi. Differt autem iste motus a Motu Indigentiæ, in duobus. Uno, quod in Motu Indigentiæ sit stimulus major naturæ malignæ et contrariæ; at in hoc motu (si modo impedimenta et vincula absint) uniuntur partes per amicitiam, licet absit natura aliena quæ litem moveat: altero, quod arctior sit unio, et tanquam majore cum delectu. In illo enim, modo evitetur corpus inimicum, corpora etiam non admodum cognata concurrunt; at in hoc coëunt substantiæ, germana plane similitudine devinctæ, et conflantur tanquam in unum. Atque hic motus omnibus corporibus compositis inest; et se facile conspiciendum in singulis daret, nisi ligaretur et frænaretur per alios corporum appetitus et necessitates, quæ istam coitionem disturbant.

Ligatur autem motus iste plerumque tribus modis: torpore corporum; fræno corporis dominantis; et motu externo. Ad torporem corporum quod attinet; certum est inesse corporibus tangibilibus pigritiam quandam secundum magis et minus, et exhorrentiam motus localis; ut, nisi excitentur, malint statu suo (prout sunt) esse contenta quam in melius se expedire. Discutitur autem iste torpor triplici auxilio: aut per calorem, aut per virtutem alicujus cognati corporis eminentem, aut per motum vividum et potentem. Atque primo quoad auxilium caloris; hinc fit, quod calor pronuntietur esse illud quod *separet Heterogenea, con-*

greget Homogenea. Quam definitionem Peripateticorum merito derisit Gilbertus; dicens eam esse perinde ac si quis diceret ac definiret hominem illud esse quod serat triticum et plantet vineas: esse enim definitionem tantum per effectus, eosque particulares.[1] Sed adhuc magis culpanda est illa definitio; quia etiam effectus illi (quales quales sunt) non sunt ex proprietate caloris, sed tantum per accidens[2] (idem enim facit frigus, ut postea dicemus), nempe ex desiderio partium homogenearum coëundi; adjuvante tantum calore ad discutiendum torporem, qui torpor desiderium illud antea ligaverat. Quoad vero auxilium virtutis inditæ a corpore cognato; illud mirabiliter elucescit in magnete armato, qui excitat in ferro virtutem detinendi ferrum per similitudinem substantiæ, discusso torpore ferri per virtutem magnetis. Quoad vero auxilium motus; conspicitur illud in sagittis ligneis, cuspide etiam lignea; quæ altius penetrant in alia ligna quam si fuissent armatæ ferro, per similitudinem substantiæ, discusso tor-

[1] For the definition we may refer to the *Margarita Philosophiæ*, xi. 3. It is founded on a passage in the *De Gen. et Corr.* ii. 2. Gilbert's censure on it is to be found in his posthumous work *De Mundo nostro sublunari Philosophia nova*, which was published by Gruter in 1651, long after the death of Bacon. It seems however, as Gruter remarks, that the work, which he suggests may have been written before the treatise *De Magnete*, published in 1600, had been read in manuscript by "viri magni et famæ celeberrimæ." "Illi perspicace in Physicis præsertim ingenio haud pœnitendæ in evolvendo operæ testimonium dederunt, quod integrum excussisse censeantur, et aliqua a vulgaribus opinionibus abhorrentia calculo suo comprobata hinc sparsim citent;" in which I do not doubt that Gruter refers to Bacon. Bacon's quotation seems to have been made from imperfect memory, as the words of the original are: — "quid illud ostendit aut quæ illa differentia ab effectu tantum in quibusdam corporibus, *congregans homogenea et disgregans heterogenea?* ac si diceres hominem animal esse carduos et sentes evellens, et fruges serens, cum istud sit agricolæ studium." — *De Mundo*, &c., i. c. 26.

[2] *i. e.* they arise indirectly.

pore ligni per motum celerem: de quibus duobus experimentis etiam in aphorismo de Instantiis Clandestinis diximus.

Ligatio vero Motus Congregationis Minoris, quæ fit per frænum corporis dominantis, conspicitur in solutione sanguinis et urinarum per frigus. Quamdiu enim repleta fuerint corpora illa spiritu agili, qui sin gulas eorum partes cujuscunque generis ipse ut domi nus totius ordinat et cohibet, tamdiu non coëunt homogenea[1] propter frænum; sed postquam ille spiritus evaporaverit, aut suffocatus fuerit per frigus, tum solutæ partes a fræno coëunt secundum desiderium suum naturale. Atque ideo fit, ut omnia corpora quæ continent spiritum acrem (ut sales, et hujusmodi) durent et non solvantur, ob frænum permanens et durabile spiritus dominantis et imperiosi.

Ligatio vero Motus Congregationis Minoris, quæ fit per motum externum, maxime conspicitur in agitationibus corporum per quas arcetur putrefactio. Omnis enim putrefactio fundatur in congregatione homogeneorum; unde paulatim fit corruptio prioris (quam vocant) formæ, et generatio novæ. Nam putrefactionem, quæ sternit viam ad generationem novæ formæ, præcedit solutio veteris; quæ est ipsa coitio ad homogeniam. Ea vero si non impedita fuerit, fit solutio simplex; sin occurrant varia quæ obstant, sequuntur putrefactiones quæ sunt rudimenta generationis novæ. Quod si (id quod nunc agitur) fiat agitatio frequens per motum externum, tum vero motus iste coitionis (qui est delicatus et mollis et indiget quiete ab externis) disturbatur et cessat; ut fieri videmus in innume-

[1] ["Heterogenea" in the original edition]; clearly a wrong reading: the sense requires "homogenea."

ris; veluti cum quotidiana agitatio aut profluentia aquæ arceat putrefactionem; venti arceant pestilentiam aëris; grana in granariis versa et agitata maneant pura; omnia denique agitata exterius non facile putrefiant interius.

Superest ut non omittatur coitio illa partium corporum, unde fit præcipue induratio et desiccatio. Postquam enim spiritus, aut humidum in spiritum versum, evolaverit in aliquo corpore porosiore (ut in ligno, osse, membrana, et hujusmodi), tum partes crassiores majore nixu contrahuntur et coëunt, unde sequitur induratio aut desiccatio: quod existimamus fieri, non tam ob Motum Nexus, ne detur vacuum, quam per motum istum amicitiæ et unionis.

Ad coitionem vero ad distans quod attinet, ea infrequens est et rara; et tamen in pluribus inest quam quibus observatur. Hujus simulacra sunt, cum bulla solvat bullam; medicamenta ex similitudine substantiæ trahant humores; chorda in diversis fidibus ad unisonum moveat chordam; et hujusmodi. Etiam in spiritibus animalium hunc motum vigere existimamus, sed plane incognitum. At eminet certe in magnete, et ferro excito. Cum autem de motibus magnetis loquimur, distinguendi plane sunt. Quatuor enim virtutes sive operationes sunt in magnete, quæ non confundi, sed separari debent; licet admiratio hominum et stupor eas commiscuerit. Una, coitionis magnetis ad magnetem, vel ferri ad magnetem, vel ferri exciti ad ferrum. Secunda, verticitatis ejus ad septentriones et austrum, atque simul declinationis ejus. Tertia, penetrationis ejus per aurum, vitrum, lapidem, omnia. Quarta, communicationis virtutis ejus de lapide in ferrum, et de ferro in ferrum, absque communicatione substantiæ. Verum

hoc loco de prima virtute ejus tantum loquimur, videlicet coitionis. Insignis etiam est motus coitionis argenti vivi et auri; adeo ut aurum alliciat argentum vivum, licet confectum in unguenta; atque operarii inter vapores argenti vivi soleant tenere in ore frustum auri, ad colligendas emissiones argenti vivi, alias crania et ossa eorum invasuras; unde etiam frustum illud paulo post albescit. Atque de Motu Congregationis Minoris hæc dicta sint.

Sit Motus Nonus, Motus *Magneticus;* qui licet sit ex genere Motus Congregationis Minoris, tamen si operetur ad distantias magnas et super massas rerum magnas, inquisitionem meretur separatam; præsertim si nec incipiat a tactu, quemadmodum plurimi, nec perducat actionem ad tactum, quemadmodum omnes motus congregativi; sed corpora tantum elevet, aut ea intumescere faciat, nec quicquam ultra. Nam si luna attollat aquas, aut turgescere aut intumescere faciat humida; aut cœlum stellatum attrahat planetas versus sua apogæa; aut sol alliget astra Veneris et Mercurii, ne longius absint a corpore ejus quam ad distantiam certam; videntur hi motus nec sub Congregatione Majore nec sub Congregatione Minore bene collocari; sed esse tanquam congregativa media et imperfecta, ideoque speciem debere constituere propriam.

Sit Motus Decimus, Motus *Fugæ;* motus scilicet Motui Congregationis Minoris contrarius; per quem corpora ex antipathia fugiunt et fugant inimica, seque ab illis separant, aut cum illis miscere se recusant. Quamvis enim videri possit in aliquibus hic motus esse motus tantum per accidens aut per consequens, respectu Motus Congregationis Minoris, quia nequeunt coire homogenea nisi heterogeneis exclusis et remotis; tamen

ponendus est motus iste per se, et in speciem constituendus, quia in multis appetitus Fugæ cernitur magis principalis quam appetitus Coitionis.

Eminet autem hic motus insigniter in excretionibus animalium; nec minus etiam in sensuum nonnullorum odiosis objectis, præcipue in olfactu et gustu. Odor enim fœtidus ita rejicitur ab olfactu, ut etiam inducat in os stomachi motum expulsionis per consensum; sapor amarus et horridus ita rejicitur a palato aut gutture, ut inducat per consensum capitis conquassationem et horrorem. Veruntamen etiam in aliis locum habet iste motus. Conspicitur enim in antiperistasibus nonnullis; ut in aëris media regione, cujus frigora videntur esse rejectiones naturæ frigidæ ex confiniis cœlestium; quemadmodum etiam videntur magni illi fervores et inflammationes, quæ inveniuntur in locis subterraneis, esse rejectiones naturæ calidæ ab interioribus terræ. Calor enim et frigus, si fuerint in quanto minore, se invicem perimunt; sin fuerint in massis majoribus et tanquam justis exercitibus, tum vero per conflictum se locis invicem summovent et ejiciunt. Etiam tradunt cinamomum et odorifera, sita juxta latrinas et loca fœtida, diutius odorem retinere; quia recusant exire et commisceri cum fœtidis. Certe argentum vivum, quod alias se reuniret in corpus integrum, prohibetur per salivam hominis, aut axungiam porci, aut terebinthinam, et hujusmodi, ne partes ejus coëant; propter malum consensum quem habent cum hujusmodi corporibus; a quibus undique circumfusis se retrahunt; adeo ut fortior sit earum Fuga ab istis interjacentibus quam desiderium uniendi se cum partibus sui similibus; id quod vocant *mortificationem* argenti vivi. Etiam quod oleum cum aqua non misceatur, non tantum in

causa est differentia levitatis, sed malus ipsorum consensus: ut videre est in spiritu vini, qui cum levior sit oleo, tamen se bene miscet cum aqua. At maxime omnium insignis est Motus Fugæ in nitro, et hujusmodi corporibus crudis, quæ flammam exhorrent; ut in pulvere pyrio, argento vivo, necnon in auro. Fuga vero ferri ab altero polo magnetis a Gilberto bene notatur non esse Fuga propria, sed conformitas, et coitio ad situm magis accommodatum.[1]

Sit Motus Undecimus, Motus *Assimilationis*, sive *Multiplicationis sui*, sive etiam *Generationis Simplicis*. Generationem autem Simplicem dicimus non corporum integralium, ut in plantis, aut animalibus; sed corporum similarium.[2] Nempe per hunc motum corpora similaria vertunt corpora alia affinia, aut saltem bene disposita et præparata, in substantiam et naturam suam; ut flamma, quæ super halitus et oleosa multiplicat se, et generat novam flammam; aër, qui super aquam et aquea multiplicat se, et generat novum aërem; spiritus vegetabilis et animalis, qui super tenuiores partes tam aquei quam oleosi in alimentis suis multiplicat se, et generat novum spiritum; partes solidæ plantarum et animalium, veluti folium, flos, caro, os, et sic de cæteris, quæ singulæ ex succis alimentorum assimilant et generant substantiam successivam et epiusiam. Neque enim quenquam cum Paracelso delirare juvet, qui (distillationibus suis scilicet occæcatus) nutritionem per separationem tantum fieri voluit; quod-

[1] "Ita coitio magnetica actus est magnetis et ferri, non actio unius, utriusque *ἐντελέχεια* non *ἔργον*, *συνεντελέχεια* et conactus potius quam sympathia; antipathia nulla est proprie magnetica. Nam fuga et declinatio terminorum, sive conversio totius, utriusque actus est ad unitatem, a conactu et *συνεντελέχεια* amborum." — *Gilbert, De Magnete*, ii. c. 4.

[2] *i. e.* bodies of uniform texture.

que in pane vel cibo lateat oculus, nasus, cerebrum, jecur;[1] in succo terræ radix, folium, flos. Etenim sicut faber ex rudi massa lapidis vel ligni, per separationem et rejectionem superflui educit folium, florem, oculum, nasum, manum, pedem, et similia; ita *archæum* illum fabrum internum ex alimento per separationem et rejectionem educere singula membra et partes asserit ille. Verum missis nugis, certissimum est partes singulas, tam similares quam organicas, in vegetabilibus et animalibus, succos alimentorum suorum fere communes, aut non multum diversos, primo attrahere cum nonnullo delectu, deinde assimilare, et vertere in naturam suam. Neque Assimilatio ista, aut Generatio Simplex, fit solum in corporibus animatis, verum et inanimata ex hac re participant; veluti de flamma et

[1] I have not been able to find any passage in Paracelsus which altogether corresponds to this remark; and in his *Modus Pharmacandi* the process of digestion is described without reference to the Archeus; nor is it said that each member "latet in pane vel cibo." "Hoc scimus, quod cujusque membri uutrimentum latitet in pane, carne, et in aliis similiter." "Quot vero modis et quibus, necnon quâ ratione membris corporis nutrimentum dividatur, nos ignoramus; hoc tantùm scimus, rem ita se habere ut diximus." — *De Mod. Pharm.* v. p. 233. (I use the edition of 1603).

Bacon has, however, correctly stated the general doctrine that alimentation is by separation; and again Paracelsus affirms that "officium vero Archei est in microcosmo purum ab impuro separare." — *De Morbis Tartareis*, iii. 195. The truth is that Paracelsus's views are so often repeated and varied in the course of his writings, that it is difficult to know how far his opinions are represented by any particular passage.

It is well to remark that, to a certain extent, the theory here so decidedly condemned has, by the recent progress of organic chemistry, been shown to be true. Nothing seems better established than that the nitrogenised components of animal bodies are derived from the corresponding elements of their food. With respect to fat, it is, I believe, a prevailing opinion at present, that animals have the power of converting into it the starch or sugar of their food; and the production of butyric acid by fermentation, has been regarded as at least an illustration of the transformation. One of the highest authorities on such a subject, however, I mean M. Boussingault, was, at least a few years ago, of a different opinion. He regarded animal fat as the representative of the fatty matters contained in the food.

aëre dictum est. Quinetiam spiritus emortuus,[1] qui in omni tangibili animato continetur, id perpetuo agit, ut partes crassiores digerat et vertat in spiritum, qui deinde exeat; unde fit diminutio ponderis et exsiccatio, ut alibi diximus. Neque etiam respuenda est in Assimilatione accretio illa, quam vulgo ab alimentatione distinguunt; veluti cum lutum inter lapillos concrescit, et vertitur in materiam lapideam; squammæ circa dentes vertuntur in substantiam non minus duram quam sunt dentes ipsi, etc. Sumus enim in ea opinione, inesse corporibus omnibus desiderium assimilandi, non minus quam coëundi ad homogenea; verum ligatur ista virtus, sicut et illa, licet non iisdem modis. Sed modos illos, necnon solutionem ab iisdem, omni diligentia inquirere oportet, quia pertinent ad senectutis refocillationem. Postremo videtur notatu dignum, quod in novem illis motibus, de quibus diximus, corpora tantum naturæ suæ conservationem appetere videntur; in hoc decimo autem propagationem.[2]

Sit Motus Duodecimus, Motus *Excitationis;* qui motus videtur esse ex genere Assimilationis, atque eo nomine quandoque a nobis promiscue vocatur. Est enim motus diffusivus, et communicativus, et transitivus, et multiplicativus, sicut et ille; atque effectu (ut pluri-

[1] By "spiritus emortuus" Bacon understands that which in the *Historia Vitæ et Mortis* he has called "spiritus mortualis." The fourth of his Canones Mobiles, in the *Historia*, &c. is this: — "In omnibus animatis duo sunt genera spirituum, spiritus mortuales quales insunt inanimatis, et superadditus spiritus vitalis." The former are such as "insunt in carne, osse, membranâ, et cæteris separatis et mortuis." I do not think there is any distinct trace of this doctrine of a spiritus mortualis in Paracelsus. In his tract *De Viribus Membrorum*, i. c. 1., he describes the functions of the spiritus vitæ in relation to the different organs, without referring to any indwelling non-vital spirit (vol. iii. p. 1. of his Philosophy).

[2] The first "motus" which Bacon mentions does not relate to concrete bodies ("corpora"), but to matter in general. The "Motus Assimilationis" is therefore the tenth of those which relate to "corpora," though it is the eleventh in the general arrangement.

mum) consentiunt, licet efficiendi modo et subjecto differant. Motus enim Assimilationis procedit tanquam cum imperio et potestate; jubet enim et cogit assimilatum in assimilantem verti et mutari. At Motus Excitationis procedit tanquam arte et insinuatione et furtim; et invitat tantum, et disponit excitatum ad naturam excitantis. Etiam Motus Assimilationis multiplicat et transformat corpora et substantias; veluti, plus fit flammæ, plus aëris, plus spiritus, plus carnis. At in Motu Excitationis, multiplicantur et transeunt virtutes tantum; et plus fit calidi, plus magnetici, plus putridi. Eminet autem iste motus præcipue in calido et frigido. Neque enim calor diffundit se in calefaciendo per communicationem primi caloris; sed tantum per Excitationem partium corporis ad motum illum qui est Forma Calidi; de quo in Vindemiatione Prima de Natura Calidi diximus. Itaque longe tardius et difficilius excitatur calor in lapide aut metallo quam in aëre, ob inhabilitatem et impromptitudinem corporum illorum ad motum illum; ita ut verisimile sit posse esse interius versus viscera terræ materias quæ calefieri prorsus respuant; quia ob condensationem majorem spiritu illo destituuntur a quo Motus iste Excitationis plerunque incipit. Similiter magnes induit ferrum nova partium dispositione et motu conformi; ipse autem nihil ex virtute perdit. Similiter fermentum panis, et flos cervisiæ, et coagulum lactis, et nonnulla ex venenis, excitant et invitant motum in massa farinaria, aut cervisia, aut caseo, aut corpore humano, successivum et continuatum; non tam ex vi excitantis quam ex prædispositione et facili cessione excitati.[1]

[1] The theory here proposed is nearly equivalent to the most recent views on the same subject, as the following passage will sufficiently show. — It is obvious that both statements, however much of truth they may involve,

Sit Motus Decimus Tertius, Motus *Impressionis;* qui Motus est etiam ex genere Motus Assimilationis, estque ex diffusivis motibus subtilissimus. Nobis autem visum est eum in speciem propriam constituere, propter differentiam insignem quam habet erga priores duos. Motus enim Assimilationis simplex corpora ipsa transformat; ita ut si tollas primum movens nihil intersit ad ea quæ sequuntur. Neque enim prima accensio in flammam, aut prima versio in aërem, aliquid facit ad flammam aut aërem in generatione succedentem. Similiter, Motus Excitationis omnino manet, remoto primo movente, ad tempora bene diuturna; ut in corpore calefacto, remoto primo calore; in ferro excito, remoto magnete; in massa farinaria, remoto fermento. At Motus Impressionis, licet sit diffusivus, et transitivus, tamen perpetuo pendere videtur ex primo movente; adeo ut sublato aut cessante illo statim deficiat et pereat; itaque etiam momento, aut saltem exiguo tempore, transigitur. Quare Motus illos Assimilationis et Excitationis, Motus *Generationis Jovis*, quia generatio manet, hunc autem motum Motum *Generationis Saturni*,

are indefinite and unsatisfactory. It is not said whether the new properties engendered depend upon new types of motion or new arrangements, though the latter is probably Liebig's opinion.

"All the phenomena of fermentation, when taken together, establish the correctness of the principle long since recognised by Laplace and Berthollet, namely, *that an atom or molecule, put in motion by any power whatever, may communicate its own motion to another atom in contact with it.*

"This is a dynamical law of the most general application, manifested everywhere when the resistance or force opposing the motion, such as the vital principle, the force of affinity, electricity, cohesion, &c., is not sufficiently powerful to arrest the motion imparted.

"This law has only recently been recognised as a cause of the alterations in forms and properties which occur in our chemical combinations; and its establishment is the greatest and most enduring acquisition which chemical science has derived from the study of fermentation."—*Liebig's Letters on Chemistry*, p. 209.

quia natus statim devoratur et absorbetur, appellare consuevimus. Manifestat se vero hic motus in tribus; in lucis radiis; sonorum percussionibus; et magneticis, quatenus ad communicationem.[1] Etenim amota luce, statim pereunt colores et reliquæ imagines ejus; amota percussione prima et quassatione corporis inde facta, paulo post perit sonus. Licet enim soni etiam in medio per ventos tanquam per undas agitentur; tamen diligentius notandum est quod sonus non tam diu durat quam fit resonatio.[2] Etenim impulsa campana, sonus ad bene magnum tempus continuari videtur; unde quis facile in errorem labatur, si existimet toto illo tempore sonum tanquam natare et hærere in aëre; quod falsissimum est. Etenim illa resonatio non est idem sonus numero, sed renovatur. Hoc autem manifestatur ex sedatione sive cohibitione corporis percussi. Si enim sistatur et detineatur campana fortiter et fiat immobilis, statim perit sonus nec resonat amplius; ut in chordis, si post primam percussionem tangatur chorda, vel digito ut in lyra, vel calamo ut in espinetis, statim desinit resonatio. Magnete autem remoto statim ferrum decidit. Luna autem a mari non potest removeri; nec terra a ponderoso dum cadit. Itaque de illis nullum fieri potest experimentum; sed ratio eadem est.

Sit Motus Decimus Quartus, Motus *Configurationis*, aut *Situs;* per quem corpora appetere videntur, non coitionem aut separationem aliquam, sed situm, et collocationem, et configurationem cum aliis. Est autem iste motus valde abstrusus, nec bene inquisitus. Atque in quibusdam videtur quasi incausabilis; licet revera (ut existimamus) non ita sit. Etenim si quæratur cur

[1] *i. e.* as regards the communication of influence.

[2] *i. e.* the original sound does not last all the time the resonance goes on.

potius cœlum volvatur ab oriente in occidentem quam ab occidente in orientem; aut cur vertatur circa polos positos juxta Ursas potius quam circa Orionem, aut ex alia aliqua parte cœli; videtur ista quæstio tanquam quædam extasis, cum ista potius ab experientia, et ut positiva[1] recipi debeant. At in natura profecto sunt quædam ultima et incausabilia; verum hoc ex illis non esse videtur. Etenim hoc fieri existimamus ex quadam harmonia et consensu mundi, qui adhuc non venit in observationem.[2] Quod si recipiatur motus terræ ab occidente in orientem, eædem manent quæstiones. Nam et ipsa super aliquos polos movetur. Atque cur tandem debeant isti poli collocari magis ubi sunt quam alibi?[3] Item verticitas, et directio, et declinatio magnetis ad hunc motum referuntur. Etiam inveniuntur in corporibus tam naturalibus quam artificialibus, præsertim consistentibus et non fluidis, collatio quædam et positura partium, et tanquam villi et fibræ, quæ diligenter investigandæ sunt; utpote sine quarum inventione corpora illa commode tractari aut regi non possunt. At circulationes illas in liquidis, per quas illa dum pressa sint, antequam se liberare possunt, se invicem relevant, ut compressionem illam ex æquo tolerent, Motui Libertatis verius assignamus.

[1] *i. e.* as merely positive facts.

[2] The most striking instance of this kind of harmony is the circumstance that all the movements of the solar system are in the same general direction, viz., from west to east. Laplace has attempted to calculate the probability that this uniformity is the result of a common cause determining the direction of their movements; but these numerical estimations of the probability of the truth of any induction are, on several accounts, altogether unsatisfactory.

[3] This passage shows that Bacon was not aware that the poles are not fixed (collocati) anywhere; in other words, that he was not acquainted with the precession of the equinoxes;—an additional proof how little of his attention had been given to mathematical physics.

Sit Motus Decimus Quintus, Motus *Pertransitionis*, sive Motus *secundum Meatus;* per quem virtutes corporum magis aut minus impediuntur aut provehuntur a mediis ipsorum, pro natura corporum et virtutum operantium, atque etiam medii. Aliud enim medium luci convenit, aliud sono, aliud calori et frigori, aliud virtutibus magneticis, necnon aliis nonnullis respective.

Sit Motus Decimus Sextus, Motus *Regius* (ita enim eum appellamus) sive *Politicus;* per quem partes in corpore aliquo prædominantes et imperantes reliquas partes frænant, domant, subigunt, ordinant, et cogunt eas aduuari, separari, consistere, moveri, collocari, non ex desideriis suis, sed prout in ordine sit et conducat ad bene esse partis illius imperantis; adeo ut sit quasi *Regimen* et *Politia* quædam, quam exercet pars regens in partes subditas. Eminet autem hic motus præcipue in spiritibus animalium, qui motus omnes partium reliquarum, quamdiu ipse in vigore est, contemperat. Invenitur autem in aliis corporibus in gradu quodam inferiore; quemadmodum dictum est de sanguine et urinis, quæ non solvuntur donec spiritus, qui partes earum commiscebat et cohibebat, emissus fuerit aut suffocatus. Neque iste motus omnino spiritibus proprius est, licet in plerisque corporibus spiritus dominentur ob motum celerem et penetrationem. Veruntamen in corporibus magis condensatis, nec spiritu vivido et vigente (qualis inest argento vivo et vitriolo) repletis, dominantur potius partes crassiores; adeo ut nisi frænum et jugum hoc arte aliqua excutiatur, de nova aliqua hujusmodi corporum transformatione minime sperandum sit. Neque vero quispiam nos oblitos esse existimet ejus quod nunc agitur; quia cum ista series

et distributio motuum ad nil aliud spectet, quam ut illorum Prædominantia per Instantias Luctæ melius inquiratur, jam inter motus ipsos Prædominantiæ mentionem faciamus. Non enim in descriptione Motus istius Regii, de Prædominantia motuum aut virtutum tractamus, sed de Prædominantia partium in corporibus. Hæc enim ea est Prædominantia, quæ speciem istam motus peculiarem constituit.

Sit Motus Decimus Septimus, Motus *Rotationis Spontaneus;* per quem corpora motu gaudentia, et bene collocata, natura sua fruuntur, atque seipsa sequuntur, non aliud, et tanquam proprios petunt amplexus. Etenim videntur corpora aut movere sine termino; aut plane quiescere; aut ferri ad terminum, ubi pro natura sua aut rotent aut quiescant. Atque quæ bene collocata sunt, si motu gaudeant, movent per circulum: motu scilicet æterno, et infinito. Quæ bene collocata sunt, et motum exhorrent, prorsus quiescunt. Quæ non bene collocata sunt, movent in linea recta (tanquam tramite brevissimo) ad consortia suorum connaturalium.[1] Recipit autem Motus iste Rotationis

[1] This passage is wholly in accordance with the Peripatetic system of physics. But the modifications which Bacon goes on to enumerate, to which, as he conceives, the eternal circular motions of the heavenly bodies may be subject, are sufficient to destroy the whole *à priori* argument in favour of such a system of astronomy as that which we find in the twelfth book of the *Metaphysics*. It has not been sufficiently observed that the Ptolemaic system is no less at variance with the Peripatetic philosophy than the heliocentrical. The attempts of Turrianus and Fracastorius to construct what may be called an orthodox system of astronomy — that is one in which all the motions should take place in circles of which the earth is the centre — was suggested chiefly, as we learn from the *Homocentrica* of the latter, by the wish to reconcile astronomy and philosophy. It had no scientific value, since it left all the phenomena of variations of parallax and apparent diameter unexplained, or, at any rate, gave an explanation of them which no astronomer would accept. It was nevertheless favourably received by the systematic Peripaticians. See, for instance, Fla-

differentias novem. Primam, centri sui, circa quod corpora movent; secundam, polorum suorum, supra quos movent; tertiam, circumferentiæ sive ambitus sui, prout distant a centro; quartam, incitationis suæ, prout celerius aut tardius rotant; quintam, consequutionis motus sui, veluti ab oriente in occidentem, aut ab occidente in orientem; sextam, declinationis a circulo perfecto per spiras longius aut propius distantes a centro suo; septimam, declinationis a circulo perfecto per spiras longius aut propius distantes a polis suis; octavam, distantiæ propioris aut longioris spirarum suarum ad invicem; nonam et ultimam, variationis ipsorum polorum, si sint mobiles; quæ ipsa ad rotationem non pertinet, nisi fiat circulariter.[1] Atque iste motus communi et inveterata opinione habetur pro proprio cœlestium. Attamen gravis de illo motu lis est inter nonnullos tam ex antiquis quam modernis, qui Rotationem terræ attribuerunt. At multo fortasse justior movetur controversia (si modo res non sit omnino extra controversiam), an motus videlicet iste (concesso quod terra stet) cœli finibus contineatur, an potius descendat, et communicetur aëri et aquis. Motum autem Rotationis in missilibus, ut in spiculis, sagittis, pilis sclopetorum, et similibus, omnino ad Motum Libertatis rejicimus.

Sit Motus Decimus Octavus, Motus *Trepidationis*, cui (ut ab astronomis intelligitur) non multum fidei

minius, *De prima Philosoph. Paraph.* p. 119. (I quote the Basle edition of 1557.)

[1] I believe the sense is that unless we restrict ourselves to circular motion, that is, unless we reject the sixth and seventh species of variation, it will not be necessary for us to suppose the poles themselves to be movable: in other words, that the phenomena of which we could by this hypothesis give an account may be adequately represented without it by means of spirals.

adhibemus.[1] Nobis autem corporum naturalium appetitus ubique serio perscrutantibus occurrit iste motus; et constitui debere videtur in speciem. Est autem hic motus veluti æternæ cujusdam captivitatis. Videlicet ubi corpora non omnino pro natura sua bene locata, et tamen non prorsus male se habentia, perpetuo trepidant, et irrequiete se agant, nec statu suo contenta, nec ulterius ausa progredi. Talis invenitur motus in corde et pulsibus animalium; et necesse est ut sit in omnibus corporibus, quæ statu ancipiti ita degunt inter commoda et incommoda, ut distracta liberare se tentent, et denuo repulsam patiantur, et tamen perpetuo experiantur.

Sit Motus Decimus Nonus et postremus, motus ille cui vix nomen motus competit, et tamen est plane motus. Quem motum, Motum *Decubitus*, sive Motum *Exhorrentiæ Motus*, vocare licet. Per hunc motum terra stat mole sua, moventibus se extremis suis in medium; non ad centrum imaginativum, sed ad unionem. Per hunc etiam appetitum omnia majorem in modum condensata motum exhorrent, atque illis pro omni appetitu est non moveri; et licet infinitis modis vellicentur

[1] The name of trepidation was given by the Alphonsine astronomers to a motion by which they imagined the starry heaven to be affected, and in virtue of which its equinoxes described small circles of nine degrees radius about those of the ninth or next superior orb. To account for this motion they introduced a tenth orb. The phenomenon, however, thus accounted for was altogether imaginary, although it is true that the length of the tropical year, by supposed variations of which the idea of trepidation was suggested, is not rigorously constant. It may be questioned whether Bacon's hesitation to accept the astronomical motion of trepidation had any better foundation than his doubts whether the proper motions of the planetary orbs were anything more than "res confictæ et suppositæ." The question of the existence or non-existence of trepidation could only be decided by a person conversant with the details of the received system of astronomy.

et provocentur ad motum, tamen naturam suam (quoad possunt) tuentur. Quod si ad motum compellantur, tamen hoc agere semper videntur ut quietem et statum suum recuperent, neque amplius moveant. Atque circa hoc certe se agilia præbent, et satis perniciter et rapide (ut pertæsa et impatientia omnis moræ) contendunt. Hujus autem appetitus imago ex parte tantum cerni potest; quia hic apud nos, ex subactione et concoctione cœlestium,[1] omne tangibile non tantum non condensatum est ad ultimitatem, sed etiam cum spiritu nonnullo miscetur.

Proposuimus itaque jam species sive elementa simplicia motuum, appetituum, et virtutum activarum, quæ sunt in natura maxime catholica. Neque parum scientiæ naturalis sub illis adumbratum est. Non negamus tamen et alias species fortasse addi posse, atque istas ipsas divisiones secundum veriores rerum venas transferri, denique in minorem numerum posse redigi. Neque tamen hoc de divisionibus aliquibus abstractis intelligimus: veluti si quis dicat corpora appetere vel conservationem, vel exaltationem, vel propagationem, vel fruitionem naturæ suæ; aut si quis dicat motus rerum tendere ad conservationem et bonum, vel universi, ut Antitypiam et Nexum; vel universitatum magnarum, ut Motus Congregationis Majoris, Rotationis, et Exhorrentiæ Motus; vel formarum specialium, ut reliquos. Licet enim hæc vera sint, tamen nisi terminentur in materia et fabrica secundum veras lineas, speculativa sunt, et minus utilia. Interim sufficient et boni erunt usus ad pensitandas Prædominantias virtutum et exquirendas Instantias Luctæ; id quod nunc agitur.

[1] In illustration of this phrase, see note 1. p. 399.

Etenim ex his quos proposuimus motibus alii prorsus sunt invincibiles; alii aliis sunt fortiores, et illos ligant, frænant, disponunt; alii aliis longius jaculantur; alii alios tempore et celeritate prævertunt; alii alios fovent, roborant, ampliant, accelerant.

Motus Antitypiæ omnino est adamantinus et invincibilis. Utrum vero Motus Nexus sit invincibilis adhuc hæremus. Neque enim pro certo affirmaverimus utrum detur Vacuum, sive coacervatum sive permistum.[1] At de illo nobis constat, rationem illam, propter quam introductum est Vacuum a Leucippo et Democrito (videlicet quod absque eo non possent eadem corpora complecti et implere majora et minora spatia), falsam esse. Est enim plane *plica materiæ* complicantis et replicantis se per spatia, inter certos fines, absque interpositione Vacui; neque est in aëre ex vacuo bis millies (tantum enim esse oportet) plus quam in auro.[2] Id

[1] "Vacuum permistum," *κενὸν ἀχώριστον*, is vacuum diffused through the interstices of any portion of matter. By "vacuum coacervatum," *κενὸν κεχωρισμένον*, is meant clear empty space. See, for this distinction, Aristotle, *Phys.* iv. 7. Hero of Alexandria, whom Bacon mentions more than once, approves of those who admit the former kind of vacuum and reject the latter. See the Introduction to his *Spiritalia*.

[It is perhaps worth observing that in the fable entitled "Cupido sive Atomus (*De Sap. Vet.* xvii.), where the theory of a vacuum is mentioned, this distinction was not introduced till Bacon revised the work in his later years. The passage which stands thus in the original edition (1609)—"Quisquis autem atomum ponit et vacuum, necessario virtutem atomi ad distans introducit"—is altered, in the edition published by Rawley after Bacon's death, to "Quisquis autem atomum asserit atque vacuum (licet istud vacuum intermistum ponat, non segregatum) necessario," &c.—*J. S.*]

[2] "Ex vacuo bis millies" is to be rendered "two thousand times as much of vacuity." Bacon (vid. suprà, II. 40.) thought spirit of wine a hundred times denser than its own vapour, and gold twenty-one times denser than spirit of wine. In the *Historia Densi et Rari*, he remarks that air is at least a hundred-fold rarer than water; and from the table there given it appears that the specific density of gold is to that of water as 1000 to 56, nearly. Hence he must have estimated the density of gold at

quod ex potentissimis corporum pneumaticorum virtutibus (quæ aliter tanquam pulveres minuti natarent in vacuo), et multis aliis demonstrationibus, nobis satis liquet. Reliqui vero Motus regunt et reguntur invicem, pro rationibus vigoris, quanti, incitationis, ejaculationis, necnon tum auxiliorum tum impedimentorum quæ occurrunt.

Exempli gratia: magnes armatus nonnullus detinet et suspendit ferrum, ad sexagecuplum pondus ipsius; eo usque dominatur Motus Congregationis Minoris super Motum Congregationis Majoris; quod si majus fuerit pondus, succumbit. Vectis tanti roboris sublevabit tantum pondus; eo usque dominatur Motus Libertatis super Motum Congregationis Majoris; sin majus fuerit pondus, succumbit. Corium tensum ad tensuram talem non rumpitur; eo usque dominatur Motus Continuationis super Motum Tensuræ; quod si ulterior fuerit tensura, rumpitur corium, et succumbit Motus Continuationis. Aqua per rimam perforationis talis effluit; eo usque dominatur Motus Congregationis Majoris super Motum Continuationis; quod si minor fuerit rima, succumbit, et vincit Motus Continuationis. In pulvere sulphuris solius immissi[1] in sclopetum cum pila, et admoto igne, non emittitur pila; in eo Motus

1900-fold that of air. Now, if we take the same weight of air and of gold, it is clear that, neglecting the space occupied by the solid matter, supposed equally dense, of each, the ratio of their densities is the same as that of the "vacua permista" which they respectively contain, and that if we take the solid matter into account the "ex vacuo" in the case of air must bear a larger ratio than that of the densities to the "ex vacuo" of gold; so that we may take it in round numbers to be as two thousand to one, as in the text.

The passage is important as showing that Bacon, notwithstanding his frequent mention of Democritus, did not adopt the atomic philosophy, though he did not absolutely reject the physical part of it.

[1] [So in the original edition.] The true reading seems to be "immisso."

Congregationis Majoris vincit Motum Hyles. At in pulvere pyrio immisso vincit Motus Hyles in sulphure, adjutus Motibus Hyles et Fugæ in nitro. Et sic de cæteris. Etenim Instantiæ Luctæ (quæ indicant Prædominantiam Virtutum, et secundum quas rationes et calculos prædominentur et succumbant) acri et sedula diligentia undique sunt conquirendæ.

Etiam modi et rationes ipsius succumbentiæ motuum diligenter sunt introspiciendæ. Nempe, an omnino cessent, vel potius usque nitantur, sed ligentur. Etenim in corporibus hic apud nos, nulla vera est quies, nec in integris nec in partibus; sed tantum secundum apparentiam. Quies autem ista apparens causatur aut per Æquilibrium, aut per absolutam Prædominantiam Motuum. Per Æquilibrium, ut in bilancibus, quæ stant si æqua sint pondera. Per Prædominantiam, ut in hydriis perforatis, ubi quiescit aqua, et detinetur a decasu, per Prædominantiam Motus Nexus. Notandum tamen est (ut diximus) quatenus nitantur motus illi succumbentes. Etenim si quis per luctam detineatur extensus in terra, brachiis et tibiis vinctis, aut aliter detentis; atque ille tamen totis viribus resurgere nitatur; non est minor nixus, licet non proficiat. Hujus autem rei conditio (scilicet utrum per Prædominantiam motus succumbens quasi annihiletur, an potius continuetur nixus, licet non conspiciatur), quæ latet in conflictibus, apparebit fortasse in concurrentiis. Exempli gratia; fiat experimentum in sclopetis, utrum sclopetus, pro tanto spatio quo emittat pilam in linea directa, sive (ut vulgo loquuntur) in puncto blanco, debiliorem edat percussionem ejaculando in supra, ubi Motus Ictus est simplex, quam desuper, ubi Motus Gravitatis concurrit cum Ictu.

Etiam canones Prædominantiarum qui occurrunt colligendi sunt. Veluti, quod quo communius est bonum quod appetitur, eo Motus est fortior: ut Motus Nexus, qui respicit communionem universi, fortior est Motu Gravitatis, qui respicit communionem densorum. Etiam quod appetitus qui sunt boni privati, non prævalent plerunque contra appetitus boni magis publici, nisi in parvis quantis. Quæ utinam obtinerent in civilibus.

XLIX.

Inter Prærogativas Instantiarum ponemus loco vicesimo quinto *Instantias Innuentes;* eas scilicet, quæ commoda hominum innuunt aut designant. Etenim ipsum *Posse* et ipsum *Scire* naturam humanam amplificant, non beant. Itaque decerpenda sunt ex universitate rerum ea quæ ad usus vitæ maxime faciunt. Verum de iis erit magis proprius dicendi locus, cum *Deductiones ad Praxim* tractabimus. Quinetiam in ipso opere Interpretationis circa singula subjecta, locum semper *Chartæ Humanæ*, sive *Chartæ Optativæ*, assignamus. Etenim et quærere et optare non inepte, pars scientiæ est.

L.

Inter Prærogativas Instantiarum ponemus loco vicesimo sexto *Instantias Polychrestas.* Eæ sunt, quæ pertinent ad varia et sæpius occurrunt; ideoque operæ et novis probationibus haud parum parcunt. Atque de instrumentis ipsis atque ingeniationibus proprius erit dicendi locus, cum Deductiones ad Praxim et Experimentandi Modos tractabimus. Quinetiam quæ adhuc cognita sunt et in usum venerunt, in Historiis Particularibus singularum artium describentur. In

præsenti autem subjungemus quædam catholica circa ea pro exemplis tantum Polychresti.

Operatur igitur homo super corpora naturalia (præter ipsam admotionem et amotionem corporum simplicem) septem præcipue modis: nempe, vel per exclusionem eorum quæ impediunt et disturbant; vel per compressiones, extensiones, agitationes, et hujusmodi; vel per calorem et frigus; vel per moram in loco convenienti; vel per frænum et regimen motus; vel per consensus speciales; vel per alternationem tempestivam et debitam, atque seriem et successionem horum omnium; aut saltem nonnullorum ex illis.

Ad primum igitur quod attinet; aër communis qui undique præsto est et se ingerit, atque radii cœlestium, multum turbant. Quæ itaque ad illorum exclusionem faciunt, merito haberi possint pro Polychrestis. Huc igitur pertinent materies et crassities vasorum, in quibus corpora ad operationem præparata reponuntur. Similiter, modi accurati obturationis vasorum, per consolidationem et *lutum sapientiæ*, ut loquuntur chymici. Etiam clausura per liquores in extimis, utilissima res est; ut cum infundunt oleum super vinum aut succos herbarum, quod expandendo se in summitate instar operculi, optime ea conservat illæsa ab aëre. Neque pulveres res malæ sunt; qui, licet contineant aërem permistum, tamen vim aëris coacervati et circumfusi arcent; ut fit in conservatione uvarum et fructuum intra arenam, et farinam. Etiam cera, mel, pix, et hujusmodi tenacia, recte obducuntur ad clausuram perfectiorem, et ad summovendum aërem et cœlestia. Etiam nos experimentum quandoque fecimus, ponendo vas, necnon aliqua alia corpora, intra argentum vivum, quod omnium longe

densissimum est ex iis quæ circumfundi possunt. Quinetiam specus et cavernæ subterraneæ magni usus sunt ad prohibendum insolationem et aërem istum apertum prædatorium; qualibus utuntur Germani Septentrionales pro granariis. Necnon repositio corporum in fundo aquarum ad hoc spectat, ut memini me quippiam audisse de utribus vini demissis in profundum puteum, ad infrigidationem scilicet; sed casu et per neglectum ac oblivionem ibidem remanentibus per multos annos, et deinde extractis; unde vinum factum est non solum non vapidum aut emortuum, sed multo magis nobile ad gustum, per commixtionem partium suarum (ut videtur) magis exquisitam. Quod si postulet res ut corpora demittantur ad fundum aquarum, veluti intra fluvios aut mare, neque tamen aquas tangant, nec in vasibus obturatis concludantur, sed aëre tantum circumdentur; bonus est usus vasis illius quod adhibitum est nonnunquam ad operandum subter aquis super navigia demersa, ut urinatores diutius manere possint sub aquis, et per vices ad tempus respirare. Illud hujusmodi erat. Conficiebatur dolium ex metallo concavum, quod demittebatur æquabiliter ad superficiem aquæ, atque sic deportabat totum aërem qui continebatur in dolio secum in fundum maris. Stabat autem super pedes tres (instar tripodis), qui longitudinis erant aliquanto minoris statura hominis; ita ut urinator posset cum anhelitus deficeret, immittere caput in cavum dolii, et respirare, et deinde opus continuare. Atque audivimus inventam esse jam machinam aliquam naviculæ aut scaphæ, quæ homines subter aquis vehere possit ad spatia nonnulla.[1] Verum sub tali vase, quale modo diximus,

[1] According to Beckmann, the first distinct mention of the diving-bell,

corpora quævis facile suspendi possint; cujus causa hoc experimentum adduximus.

Est et alius usus diligentis et perfectæ clausuræ corporum: nempe, non solum ut prohibeatur aditus aëris per exterius (de quo jam dictum est), verum etiam ut cohibeatur exitus spiritus corporis, super quod fit operatio per interius. Necesse est enim ut operanti circa corpora naturalia constet de summis suis: viz. quod nihil expirarit aut effluxerit. Fiunt enim profundæ alterationes in corporibus, quando, natura prohibente annihilationem, ars prohibeat etiam deperditionem aut evolationem alicujus partis. Atque hac de re invaluit opinio falsa (quæ si vera esset, de ista conservatione summæ certæ absque diminutione esset fere desperandum): viz. spiritus corporum, et aërem majori gradu caloris attenuatum, nullis vasorum claustris posse contineri, quin per poros vasorum subtiliores evolent. Atque in hanc opinionem adducti sunt homines per vulgata illa experimenta, poculi inversi super aquam cum candela aut charta inflammata, ex quo fit ut aqua sursum attrahatur; atque similiter ventosarum, quæ super flammam calefactæ trahunt carnes. Existimant enim in utroque experimento aërem attenuatum emitti, et inde *quantum* ipsius minui, ideoque aquam aut carnes per Nexum succedere. Quod falsissimum est. Aër enim non *quanto* diminuitur, sed spatio contrahitur; neque incipit motus iste successionis aquæ, antequam fiat extinctio flammæ aut refrigeratio aëris; adeò ut medici, quo fortius attrahant ventosæ, ponant spongias frigidas[1] aqua ma-

at least in modern times, is to be found in Fainsius, as quoted by Schott. Fainsius gives an account of some Greeks who exhibited a diving-bell at Toledo, before Charles the Fifth and his court, in 1538.

[1] The right reading is doubtless "frigidâ;" but the sense is obvious.

defactas super ventosas. Itaque non est cur homines multum sibi metuant de facili exitu aëris aut spirituum. Licet enim verum sit etiam solidissima corpora habere suos poros, tamen ægre patitur aër aut spiritus comminutionem sui ad tantam subtilitatem; quemadmodum et aqua exire recusat per rimam minusculam.

De secundo vero modo ex septem prædictis illud imprimis notandum est, valere certe compressiones et hujusmodi violentias ad motum localem, atque alia id genus, potentissime; ut in machinis et missilibus; etiam ad destructionem corporis organici, atque earum virtutum quæ consistunt plane in motu. Omnis enim vita, immo etiam omnis flamma et ignitio destruitur per compressiones; ut et omnis machina corrumpitur et confunditur per easdem. Etiam ad destructionem virtutum quæ consistunt in posituris, et dissimilaritate partium paulo crassiore; ut in coloribus (neque enim idem color floris integri et contusi, neque succini integri et pulverizati); etiam in saporibus (neque enim idem sapor pyri immaturi, et ejusdem compressi ac subacti; nam manifesto dulcedinem majorem concipit). Verum ad transformationes et alterationes nobiliores corporum similarium non multum valent istæ violentiæ; quia corpora per eas non acquirunt consistentiam aliquam novam constantem et quiescentem, sed transitoriam, et nitentem semper ad restitutionem et liberationem sui. Attamen non abs re foret hujus rei facere experimenta aliqua diligentiora; ad hoc scilicet, utrum condensatio corporis bene similaris (qualia sunt aër, aqua, oleum, et hujusmodi), aut rarefactio similiter per violentiam indita, possint fieri constantes et fixæ et quasi mutatæ in naturam. Id quod primo experi-

endum per moram simplicem; deinde per auxilia et consensus. Atque illud nobis in promptu fuisset (si modo in mentem venisset), cum aquam (de qua alibi) per malleationes et pressoria condensavimus, antequàm erumperet. Debueramus enim sphæram complanatam per aliquot dies sibi permisisse, et tum demum aquam extraxisse; ut fieret experimentum, utrum statim impletura fuisset talem dimensionem, qualem habebat ante condensationem. Quod si non fecisset aut statim, aut certe paulo post, constans videlicet facta videri potuisset ista condensatio; sin minus, apparuisset factam fuisse restitutionem, et compressionem fuisse transitoriam. Etiam simile quiddam faciendum erat circa extensionem aëris in ovis vitreis. Etenim debuerat fieri, post exuctionem fortem, subita et firma obturatio; deinde debuerant ova illa manere ita obturata per nonnullos dies; et tum demum experiendum fuisset, utrum aperto foramine attractus fuisset aër cum sibilo, aut etiam attracta fuisset tanta quantitas aquæ post immersionem, quanta fuisset ab initio, si nulla adhibita fuisset mora. Probabile enim, aut saltem dignum probatione est, hæc fieri potuisse et posse; propterea quod in corporibus paulo magis dissimilaribus similia efficiat mora temporis. Etenim baculum per compressionem curvatum post aliquod tempus non resilit; neque id imputandum est alicui deperditioni ex quanto ligni per moram; nam idem fiet in lamina ferri (si augeatur mora), quæ non est expirabilis. Quod si non succedat experimentum per moram simplicem, tamen non deserendum est negotium, sed auxilia alia adhibenda. Non enim parum lucri fit, si per violentias indi possint corporibus naturæ fixæ et constantes. Hac enim ratione aër possit

verti in aquam per condensationes, et complura alia id genus. Dominus enim est homo motuum violentorum, magis quam cæterorum.

At tertius ex septem modis, refertur ad magnum illud organum, tam naturæ quam artis, quoad operandum; videlicet calidum et frigidum. Atque in hac parte claudicat plane potentia humana, tanquam ex uno pede. Habemus enim calorem ignis, qui caloribus solis (prout ad nos deferuntur) et caloribus animalium quasi infinitis partibus potentior est et intensior. At deest frigus, nisi quale per tempestates hyemales, aut per cavernas, aut per circundationes nivis et glaciei, haberi potest: quod in comparatione æquari potest cum calore fortasse solis meridiano in regione aliqua ex torridis, aucto insuper per reverberationes montium et parietum: nam hujusmodi utique tam calores quam frigora ab animalibus ad tempus exiguum tolerari possunt. Nihili autem sunt fere præ calore fornacis ardentis, aut alicujus frigoris quod huic gradui respondeat. Itaque omnia hic apud nos vergunt ad rarefactionem, et desiccationem, et consumptionem: nihil fere ad condensationem et intenerationem, nisi per misturas et modos quasi spurios. Quare Instantiæ Frigoris omni diligentia sunt conquirendæ; quales videntur inveniri in expositione corporum super turres quando gelat acriter; in cavernis subterraneis; circundationibus nivis et glaciei in locis profundioribus, et ad hoc excavatis; demissione corporum in puteos; sepulturis corporum in argento vivo et metallis; immersione corporum in aquis, quæ vertunt ligna in lapides; defossione corporum in terra (qualis fertur apud Chinenses esse confectio porcellanæ, ubi massæ ad hoc factæ dicuntur manere intra

terram per quadraginta aut quinquaginta annos, et transmitti ad hæredes, tanquam mineræ quædam artificiales); et hujusmodi. Quinetiam quæ interveniunt in natura condensationes, factæ per frigora, similiter sunt investigandæ; ut, causis eorum cognitis, transferri possint in artes. Quales cernuntur in exudatione marmoris et lapidum; in rorationibus super vitra per interius fenestrarum, sub auroram, post gelu noctis; in originibus et collectionibus vaporum in aquas sub terra, unde sæpe scaturiunt fontes; et quæcunque sunt hujus generis.

Inveniuntur autem, præter illa quæ sunt frigida ad tactum, quædam alia potestate frigida, quæ etiam condensant; veruntamen operari videntur super corpora animalium tantum, et vix ultra. Hujus generis se ostendunt multa in medicinis et emplastris. Alia autem condensant carnes et partes tangibiles; qualia sunt medicamenta astringentia, atque etiam inspissantia; alia condensant spiritus; id quod maxime cernitur in soporiferis. Duplex autem est modus condensationis spirituum, per medicamenta soporifera, sive provocantia somnum: alter per sedationem motus; alter per fugam spirituum. Etenim viola, rosa sicca, lactuca, et hujusmodi benedicta sive benigna, per vapores suos amicos et moderate refrigerantes, invitant spiritus ut se uniant, et ipsorum acrem et inquietum motum compescunt. Etiam aqua rosacea, apposita ad nares in deliquiis animæ, spiritus resolutos et nimium relaxatos se recipere facit, et tanquam alit. At opiata et eorum affinia spiritus plane fugant, ex qualitate sua maligna et inimica. Itaque si applicentur parti exteriori, statim aufugiunt spiritus ab illa parte, nec amplius libenter influunt: sin sumantur interius, va-

pores eorum, ascendentes ad caput, spiritus in ventriculis cerebri contentos undequaque fugant; cumque se retrahant spiritus neque in aliam partem effugere possint, per consequens coëunt et condensantur; et quandoque plane extinguuntur et suffocantur; licet rursus eadem opiata moderate sumpta, per accidens secundarium (videlicet condensationem illam quæ a coitione succedit), confortent spiritus, eosque reddant magis robustos, et retundant eorum inutiles et incensivos[1] motus, ex quo ad curas morborum, et vitæ prolongationem haud parum conferant.

Etiam præparationes corporum ad excipiendum Frigus non sunt omittendæ; veluti quod aqua parum tepida facilius conglacietur quam omnino frigida, et hujusmodi.

Præterea, quia natura Frigus tam parce suppeditat, faciendum est quemadmodum pharmacopolæ solent; qui quando simplex aliquod haberi non possit, capiunt succedaneum ejus, et *quid* pro *quo*, ut vocant; veluti lignum aloes pro xylobalsamo,[2] cassiam pro cinamomo. Simili modo diligenter circumspiciendum est, si quæ sint succedanea frigoris; videlicet quibus modis fieri possint condensationes in corporibus, aliter quam per frigus, quod illas efficit ut opus suum proprium. Illæ autem condensationes videntur intra quaternum numerum (quantum adhuc liquet) contineri. Quarum prima videtur fieri per contransionem simplicem; quæ parum potest ad densitatem constantem (resiliunt enim corpora) sed nihilominus forte res auxiliaris esse queat. Secunda fit per con-

[1] Exciting.

[2] Xylobalsamum is the technical name of the twigs of the tree which yields the balm of Gilead.

tractionem partium crassiorum in corpore aliquo, post evolationem aut exitum partium tenuiorum, ut fit in indurationibus per ignem, et repetitis extinctionibus metallorum, et similibus. Tertia fit per coitionem partium homogenearum, quæ sunt maxime solidæ in corpore aliquo, atque antea fuerant distractæ, et cum minus solidis commistæ: veluti in restitutione mercurii sublimati, qui in pulvere longe majus occupat spatium quam mercurius simplex, et similiter in omni repurgatione metallorum a scoriis suis. Quarta fit per consensus, admovendo quæ ex vi corporum occulta condensant; qui consensus adhuc raro se ostendunt; quod mirum minime est, quoniam antequam inventio succedat Formarum et Schematismorum, de inquisitione consensuum [1] non multum sperandum est. Certe quoad corpora animalium, dubium non est quin sint complures medicinæ, tam interius quam exterius sumptæ, quæ condensant tanquam per consensum, ut paulo ante diximus. Sed in inanimatis rara est hujusmodi operatio. Percrebuit sane, tam scriptis quam fama, narratio de arbore in una ex insulis sive Terceris sive Canariis (neque enim bene memini), quæ perpetuo stillat; adeo ut inhabitantibus nonnullam commoditatem aquæ præbeat.[2] Paracelsus autem ait, herbam vocatam *Rorem Solis* meridie et fervente sole rore impleri, cum aliæ herbæ undique sint

[1] Consensus is equivalent to *συμπάθεια*.

[2] This wonderful tree is described in Jonston's *Dendrographia*, published at Frankfort in 1669. See book the tenth, c. 4. One of the authorities he refers to is Cardan (De variet. rerum), from whom not improbably Bacon derived the story. The tree is said to be found in the island of Ferro. Cardan, with more than usual caution, remarks, at the close of the account he gives of it: "Sed postquam hoc tot scriptores affirmant, fieri potest ut tale aliquid contingat, sed modus nondum perspectus est." — *De rerum variet.* vi. c. 22. Compare *Oviedo in Ramusio*, iii. 71. a.

siccæ.[1] At nos utramque narrationem fabulosam esse existimamus. Omnino autem illæ instantiæ nobilissimi forent usus, et introspectione dignissimæ, si essent veræ. Etiam rores illos mellitos, et instar mannæ, qui super foliis quercus inveniuntur mense Maio, non existimamus fieri et densari a consensu aliquo, sive a proprietate folii quercus; sed cum super aliis foliis pariter cadant, contineri scilicet et durare in foliis quercus quia sunt bene unita, nec spongiosa, ut plurima ex aliis.

Calorem vero quod attinet, copia et potestas nimirum homini abunde adest; observatio autem et inquisitio deficit in nonnullis, iisque maxime necessariis, utcunque spagyrici se venditent. Etenim caloris intensioris opificia exquiruntur et conspiciuntur; remissioris vero, quæ maxime in vias naturæ incidunt, non tentantur, ideoque latent. Itaque videmus per vulcanos istos qui in pretio sunt, spiritus corporum magnopere exaltari, ut in aquis fortibus, et nonnullis aliis olesis chymicis; partes tangibiles indurari, et emisso volatili, aliquando figi; partes homogeneas separari; etiam corpora heterogenea grosso modo incorporari et commisceri; maxime autem compages corporum compositorum et subtiliores schematismos destrui et confundi. Debuerant autem opificia caloris lenioris tentari et exquiri; unde subtiliores misturæ et schematismi ordinati gigni possint et educi, ad exemplum naturæ et imitationem operum solis; quemadmodum in aphorismo de Instantiis Fœderis quædam adumbravimus. Opificia enim naturæ trans-

[1] I have not been able to find this in Paracelsus. It seems, however, to accord with his theory of dew, — namely, that it is an exudation from the sun and stars; the suppression of which would lead to the formation of additional suns.

iguntur per longe minores portiones, et posituras magis exquisitas et varias, quam opificia ignis, prout nunc adhibetur. Tum vero videatur homo revera auctus potestate, si per calores et potentias artificiales opera naturæ possint specie repræsentari, virtute perfici, copia variari; quibus addere oportet accelerationem temporis. Nam rubigo ferri longo tempore procedit, at versio in crocum Martis subito; et similiter de ærugine et cerussa; christallum longo tempore conficitur, vitrum subito conflatur; lapides longo tempore concrescunt, lateres subito coquuntur, etc. Interim (quod nunc agitur) omnes diversitates caloris cum effectibus suis respective diligenter et industrie undique sunt colligendæ et exquirendæ: cœlestium, per radios suos directos, reflexos, refractos, et unitos in speculis comburentibus; fulguris, flammæ, ignis carbonum; ignis ex diversis materiis; ignis aperti, conclusi, angustiati et inundantis, denique per diversas fabricas fornacium qualificati; ignis flatu exciti, quieti et non exciti; ignis ad majorem aut minorem distantiam remoti; ignis per varia media permeantis: calorum humidorum, ut balnei Mariæ,[1] fimi, caloris animalium per exterius, caloris animalium per interius, fœni conclusi: calorum aridorum, cineris, calcis, arenæ tepidæ; denique calorum cujusvis generis cum gradibus eorum.

[1] This is properly "balneum maris;" that is, a mode of communicating heat to any substance by putting it into a vessel which is placed in another containing water. The latter being put on the fire, the former and its contents become gradually and moderately heated. The reason of the name is obvious. From "balneum maris" the French made by a kind of translation (the final *s* not being sounded) "bain marie;" and the form in the text is, I think, merely a retranslation of the French phrase, the meaning of the second word being mistaken. Balneum Mariæ is however, I believe, a common phrase with old writers on chemistry.

Præcipue vero tentanda est inquisitio et inventio effectuum et opificiorum caloris accedentis et recedentis graduatim, et ordinatim, et periodice, et per debita spatia et moras. Ista enim inæqualitas ordinata revera filia cœli[1] est, et generationis mater; neque a calore aut vehementi, aut præcipiti, aut subsultorio, aliquid magni expectandum est. Etenim et in vegetabilibus hoc manifestissimum est; atque etiam in uteris animalium magna est caloris inæqualitas, ex motu, somno, alimentationibus et passionibus fœmellarum quæ uterum gestant; denique in ipsis matricibus terræ, iis nimirum in quibus metalla et fossilia efformantur, locum habet et viget ista inæqualitas. Quo magis notanda est inscitia aliquorum alchymistarum ex reformatis,[2] qui per calores æquabiles lampadum et hujusmodi, perpetuo uno tenore ardentium, se voti compotes fore existimarunt. Atque de opificiis et effectibus caloris hæc dicta sint. Neque vero tempestivum est illa penitus scrutari antequam Rerum Formæ et Corporum Schematismi ulterius investigati fuerint, et in lucem prodierint. Tum enim quærenda et adoperanda et aptanda sunt instrumenta, quando de exemplaribus constiterit.

Quartus modus operandi est per moram, quæ certe et promus et condus naturæ est, et quædam dispensatrix. Moram appellamus, cum corpus aliquod sibi permittitur ad tempus notabile, munitum interim et defensum ab aliqua vi externa. Tum enim motus intestini se produnt et perficiunt, cum motus extranei et adventitii cessant. Opera autum ætatis sunt longe subtiliora quam ignis. Neque enim possit fieri talis

[1] *i. e.* of the heavens, physically; because of the varying warmth of the seasons.

[2] *i. e.* of the reformed school.

clarificatio vini per ignem, qualis fit per moram; neque etiam incinerationes per ignem tam sunt exquisitæ, quam resolutiones et consumptiones per sæcula. Incorporationes etiam, et mistiones subitæ et præcipitatæ per ignem, longe inferiores sunt illis, quæ fiunt per moram. At dissimilares et varii schematismi, quos corpora per moras tentant (quales sunt putredines), per ignem aut calorem vehementiorem destruuntur. Illud interim non abs re fuerit notare; motus corporum penitus conclusorum habere nonnihil ex violento. Incarceratio enim illa impedit motus spontaneos corporis. Itaque mora in vase aperto plus facit ad separationes; in vase penitus clauso ad commistiones; in vase nonnihil clauso, sed subintrante aëre, ad putrefactiones; utcunque de opificiis et effectibus moræ undique sunt diligenter conquirendæ instantiæ.

At regimen motus (quod est quintus ex modis operandi) non parum valet. Regimen autem motus vocamus, cum corpus aliud occurrens corporis alterius motum spontaneum impedit, repellit, admittit, dirigit. Hoc vero plerunque in figuris et situ vasorum consistit. Etenim conus erectus juvat ad condensationem vaporum in alembicis; at conus inversus juvat ad defæcationem sacchari in vasis resupinatis. Aliquando autem sinuatio requiritur,[1] et angustiatio, et dilatatio per vices, et hujusmodi. Etiam omnis percolatio huc spectat; scilicet cum corpus occurrens, uni parti corporis alterius viam aperit, alteri obstruit. Neque semper percolatio aut aliud regimen motus fit per extra; sed etiam per corpus in corpore: ut cum lapilli immittuntur in aquas ad colligendam limositatem ipsarum; syrupi clarificantur cum albuminibus ovorum, ut

[1] As in a still.

crassiores partes adhærescant, et postea separari possint. Etiam huic regimini motus satis leviter et inscite attribuit Telesius figuras animalium, ob rivulos scilicet et loculos matricis.[1] Debuerat autem notare similem efformationem in testis ovorum, ubi non sunt rugæ aut inæqualitas. At verum est regimen motus efformationes perficere in modulis et proplasticis.[2]

Operationes vero per consensus aut fugas (qui sextus modus est) latent sæpenumero in profundo. Istæ enim (quas vocant) proprietates occultæ, et specificæ, et sympathiæ, et antipathiæ, sunt magna ex parte corruptelæ philosophiæ. Neque de consensibus rerum inveniendis multum sperandum est, ante inventionem Formarum et schematismorum simplicium. Consensus enim nil aliud est quam symmetria Formarum et Schematismorum ad invicem.

Atqui majores et magis catholici rerum consensus non prorsus obscuri sunt. Itaqua ab iis ordiendum. Eorum prima et summa diversitas ea est; ut quædam corpora copia et raritate materiæ admodum discrepent, schematismis consentiant: alia contra copia et raritate materiæ consentiant, schematismis discrepent. Nam

[1] Telesius's doctrine of the formation of the embryo is essentially the same as Galen's, namely that a system of arteries &c. must be first of all formed in the germ, and that these, by applying themselves to corresponding parts on the surface of the matrix, determine the channels through which nourishment is supplied, and therefore (mediately) the development of the different members of the fœtus. But it does not seem that he would have admitted that the smoothness of the shells of eggs was an objection to his theory. At any rate, he illustrates it by reference to the appearances presented by an egg opened during incubation. *De rerum naturâ*, vi. c. 4. and 40.

[2] The proper word for what we call a model is "proplasma," which is used in a Latin form by Pliny. I have not seen any authority for such an adjective as "proplasticus." What Bacon means is not exactly a model, but a mould for casting.

non male notatum est a chymicis, in principiorum suorum triade, sulphur et mercurium[1] quasi per universitatem rerum permeare. (Nam de sale inepta ratio est, sed introducta ut possit comprehendere corpora terrea, sicca, et fixa.) At certe in illis duobus videtur consensus quidam naturæ ex maxime catholicis conspici. Etenim consentiunt sulphur; oleum, et exhalatio pinguis; flamma; et fortasse corpus stellæ. Ex altera parte consentiunt mercurius; aqua et vapores aquei; aër; et fortasse æther purus et interstellaris. Attamen istæ quaterniones geminæ, sive magnæ rerum tribus (utraque intra ordines suos) copia materiæ atque densitate immensum differunt, sed schematismo valde conveniunt; ut in plurimis se produnt. At contra metalla diversa copia et densitate multum conveniunt (præsertim respectu vegetabilium, etc.), sed schematismo multifariam differunt; et similiter vegetabilia et animalia diversa schematismis quasi infinitis variantur, sed intra copiam materiæ sive densitatem paucorum graduum continentur.

Sequitur consensus maxime post priorem catholicus, videlicet corporum principalium et fomitum suorum; videlicet menstruorum,[2] et alimentorum. Itaque ex-

[1] This triad is the fundamental point of Paracelsus's chemical and medical philosophy. See his works throughout, and particularly the tract *De tribus primis essentiis*, contained in the third book of his philosophical works.

[2] By "menstrua" are meant the substances out of which any species of mineral is generated, or, in other words, the causa materialis of its existence. See, on the generation of metals and other minerals, the fourth and fifth books of Agricola's work *De ortu et causis fossilium*. He gives an account of the opinions of Aristotle, Theophrastus, &c. In modern chemistry the word menstruum is nearly equivalent to solvent. By the school of Paracelsus the word is used so vaguely that it is difficult to determine what idea they attached to it, or how they derived their sense of the word from its original signification. When the word is used as in the text, the

quirendum, sub quibus climatibus, et in qua tellure, et ad quam profunditatem metalla singula generentur; et similiter de gemmis, sive ex rupibus, sive inter mineras natis; in qua gleba terræ, arbores singulæ, et frutices, et herbæ potissimum proveniant, et tanquam gaudeant; et insimul quæ impinguationes, sive per stercorationes cujuscunque generis, sive per cretam, arenam maris, cineres, etc., maxime juvent; et quæ sint ex his pro varietate glebarum magis aptæ et auxiliares. Etiam insitio et inoculatio arborum et plantarum, earumque ratio, quæ scilicet plantæ super quas fœlicius inserantur, etc., multum pendet de consensu. In qua parte non injucundum foret experimentum quod noviter audivimus esse tentatum, de insitione arborum sylvestrium (quæ hucusque in arboribus hortensibus fieri consuevit), unde folia et glandes majorem in modum amplificantur, et arbores fiunt magis umbrosæ. Similiter, alimenta animalium respective notanda sunt in genere, et cum negativis. Neque enim carnivora sustinent herbis nutriri; unde etiam Ordo Folitanorum (licet voluntas humana plus possit quam animantium cæterorum super corpus suum), post experientiam factam (ut aiunt), tanquam ab humana natura non tolerabilis, fere evanuit.[1] Etiam materiæ diversæ

metaphor seems to be taken from the Aristotelian theory of generation, in which *κατὰ τὴν πρώτην ὑλήν ἐστιν ἡ τῶν καταμηνίων φύσις.*

[1] Bacon doubtless refers to the austerities of the order of Feüillans. Jean de la Barrière, after holding the Cistercian abbey of Feüillans in commendam for eleven years, renounced the world in 1573, and in the course of a few years introduced a most austere rule of life into the abbey of which he was the head. His monks knelt on the floor during their refections, and some of them were in the habit of drinking out of skulls. They abstained from eggs, fish, butter, oil, and even salt, and confined themselves to pottage made of herbs boiled in water, and bread so coarse and black that beasts refused to eat of it. After a while they gave up wine also. Clement VIII. permitted the society to draw up constitutions for the establishment of their

putrefactionum, unde animalcula generantur, notandæ sunt.

Atque consensus corporum principalium erga subordinata sua (tales enim ii possint censeri quos notavimus) satis in aperto sunt. Quibus addi possunt sensuum consensus erga objecta sua. Qui consensus cum manifestissimi sint; bene notati et acriter excussi, etiam aliis consensibus qui latent magnam præbere possint lucem.

At interiores corporum consensus et fugæ, sive amicitiæ et lites (tædet enim nos fere vocabulorum sympathiæ et antipathiæ, propter superstitiones et inania), aut falso ascriptæ, aut fabulis conspersæ, aut per neglectum raræ admodum sunt. Etenim si quis asserat inter vineam et brassicam esse dissidium, quia juxta sata minus læte proveniunt, præsto ratio est:[1] quod utraque planta succulenta sit et deprædatrix, unde al-

rule. By these the excessive rigour of their way of life was checked, which was done in obedience to the Pope, and in consequence of the deaths of fourteen monks in a single week at Feüillans. These constitutions were ratified in 1595. Assuming, of which there seems no doubt, that the Folitani of Bacon are the Feüillans, I may remark that the latinised form of Feüillans used is Fuliensis, as an adjective; the proper style of the society being "Congregatio Cistertiomonastica B. Mariæ Fuliensis." I have not seen the work of Morotius to which Helyot, from whom the preceding account is taken, refers; but in that of C. Henrique, also mentioned by Helyot, I do not find any authority for *Folitani*. It is probable that Bacon's chief information on the subject was gathered orally during his residence in France, before the Feüillans had ceased from their first love. The expression "ordo . . . fere evanuit" must be taken to mean that the severe rule that they had at first was given up. See Helyot, *Hist. des Ordres Monastiques*, ivme partie, c. 38. Spondanus, *An.* 1586, iv. For some particulars of the early history of the Abbey of Feüillans, and especially for the will of Jean de la Barrière, see *Voyage Littéraire de deux Bénédictins*, ii. p. 16.

[1] On account apparently of this enmity between the vine and the cabbage, the latter was thought to prevent intoxication. See Lemmius, *De occultis naturæ miraculis*, ii. 17. On the subject of similar enmities, see the same work, iv. 10.; or Cardan's treatise, *De rerum varietate*, and particularly the *Theatrum sympatheticum*.

tera alteram defraudat. Si quis asserat esse consensum et amicitiam inter segetes et cyaneum, aut papaver sylvestre, quia herbæ illæ fere non proveniunt nisi in arvis cultis: debuit is potius asserere dissidium esse inter ea, quia papaver et cyaneus emittuntur et creantur ex tali succo terræ qualem segetes reliquerint et repudiaverint; adeo ut satio segetum terram præparet ad eorum proventum. Atque hujusmodi falsarum ascriptionum magnus est numerus. Quoad fabulas vero, illæ omnino sunt exterminandæ. Restat tenuis certe copia eorum consensuum, qui certo probati sunt experimento; quales sunt magnetis et ferri, atque auri et argenti vivi, et similium. At in experimentis chymicis circa metalla inveniuntur et alii nonnulli observatione digni. Maxima vero frequentia eorum (ut in tanta paucitate) invenitur in medicinis nonnullis, quæ ex proprietatibus suis occultis (quas vocant) et specificis, respiciunt aut membra, aut humores, aut morbos, aut quandoque naturas individuas. Neque omittendi sunt consensus inter motus et affectus lunæ et passiones corporum inferiorum, prout ex experimentis agriculturæ, nauticæ, et medicinæ, aut alias cum delectu severo et sincero colligi et recipi possint. Verum instantiæ universæ consensuum secretiorum quo magis sunt infrequentes, eo majori cum diligentia sunt inquirendæ, per traditiones, et narrationes fidas et probas; modo hoc fiat absque ulla levitate, aut credulitate, sed fide anxia et quasi dubitabunda. Restat consensus corporum modo operandi tanquam inartificialis, sed usu polychrestus, qui nullo modo omittendus est, sed sedula observatione investigandus. Is est coitio sive unio corporum, proclivis aut difficilis, per compositionem, sive appositionem simplicem. Etenim corpora nonnulla fa

cile et libenter commiscentur et incorporantur, alia autem ægre et perverse: veluti pulveres melius incorporantur cum aquis; calces et cineres, cum oleis; et sic de similibus. Neque tantum sunt colligendæ instantiæ propensionis aut aversionis corporum erga misturam, sed etiam collocationis partium, et distributionis, et digestionis, postquam commista sint; denique et prædominantiæ post misturam transactam.

Superest ultimo loco ex modis septem operandi, septimus et postremus; operatio scilicet per alternationem et vicissitudines priorum sex; de quo antequam in singulos illos paulo altius fuerit inquisitum, tempestivum non foret exempla proponere. Series autem sive catena hujusmodi alternationis, prout ad singula effecta accommodari possit, res est et cognitu maxime difficilis, et ad opera maxime valida. Summa autem detinet et occupat homines impatientia hujusmodi tam inquisitionis, quam praxeos; cum tamen sit instar fili labyrinthi, quoad opera majora. Atque hæc sufficiant ad exemplum Polychresti.

LI.

Inter Prærogativas Instantiarum, ponemus loco vicesimo septimo atque ultimo *Instantias Magicas*. Hoc nomine illas appellamus, in quibus materia aut efficiens tenuis aut parva est, pro magnitudine operis et effectus qui sequitur; adeo ut etiamsi fuerint vulgares, tamen sint instar miraculi; aliæ primo intuitu, aliæ etiam attentius contemplanti. Has vero natura ex sese subministrat parce; quid vero factura sit sinu excusso, et post inventionem Formarum, et Processuum, et Schematismorum, futuris temporibus apparebit. At ista effecta Magica (quantum adhuc conjicimus) fiunt tri-

bus modis: aut per multiplicationem sui, ut in igne, et venenis, quæ vocant specifica; necnon in motibus, qui transeunt et fortificantur de rota in rotam; aut per excitationem sive invitationem in altero, ut in magnete, qui excit acus innumeras, virtute nullatenus deperdita aut diminuta; aut in fermento, et hujusmodi; aut per anteversionem motus, ut dictum est de pulvere pyrio, et bombardis, et cuniculis: quorum priores duo modi indagationem consensuum requirunt; tertius, mensuræ motuum. Utrum vero sit aliquis modus mutandi corpora per minima (ut vocant), et transponendi subtiliores materiæ schematismos (id quod ad omnimodas corporum transformationes pertinet, ut ars brevi tempore illud facere possit, quod natura per multas ambages molitur), de eo nulla hactenus nobis constant indicia. Quemadmodum autem in solidis et veris aspiramus ad ultima et summa; ita vana et tumida perpetuo odimus, et quantum in nobis est profligamus.

LII.

Atque de Dignitatibus sive Prærogativis Instantiarum hæc dicta sint. Illud vero monendum, nos in hoc nostro Organo tractare logicam, non philosophiam. Sed cum logica nostra doceat intellectum et erudiat ad hoc, ut non tenuibus mentis quasi claviculis rerum abstracta captet et prenset (ut logica vulgaris), sed naturam revera persecet, et corporum virtutes et actus, eorumque leges in materia determinatas inveniat; ita ut non solum ex natura mentis, sed ex natura rerum quoque hæc scientia emanet; mirum non est, si ubique naturalibus contemplationibus et experimentis, ad exempla artis nostræ, conspersa fuerit et illustrata. Sunt autem (ut ex iis quæ dicta sunt patet) Prærogativæ

Intantiarum numero 27; nominibus, Instantiæ Solitariæ: Instantiæ Migrantes: Instantiæ Ostensivæ: Instantiæ Clandestinæ: Instantiæ Constitutivæ: Instantiæ Conformes: Instantiæ Monodicæ: Instantiæ Deviantes: Instantiæ Limitaneæ: Instantiæ Potestatis: Instantiæ Comitatus et Hostiles: Instantiæ Subjunctivæ: Instantiæ Fœderis: Instantiæ Crucis: Instantiæ Divortii: Instantiæ Januæ: Instantiæ Citantes: Instantiæ Viæ: Instantiæ Supplementi: Instantiæ Persecantes: Instantiæ Virgæ: Instantiæ Curriculi: Doses Naturæ: Instantiæ Luctæ: Instantiæ Innuentes: Instantiæ Polychrestæ: Instantiæ Magicæ. Usus autem harum instantiarum, in quo instantias vulgares excellunt, versatur in genere aut circa partem informativam; aut circa operativam; aut circa utramque. Atque quoad informativam, juvant illæ aut sensum, aut intellectum. Sensum, ut quinque Instantiæ Lampadis: Intellectum, aut accelerando Exclusivam Formæ, ut Solitariæ; aut angustiando et propius indicando Affirmativam Formæ, ut Migrantes, Ostensivæ, Comitatus, cum Subjunctivis; aut erigendo intellectum, et ducendo ad genera et naturas communes; idque aut immediate, ut Clandestinæ, Monodicæ, Fœderis; aut gradu proximo, ut Constitutivæ; aut gradu infimo, ut Conformes; aut rectificando Intellectum a consuetis, ut Deviantes; aut ducendo ad Formam Magnam, sive Fabricam Universi,[1] ut Limitaneæ; aut cavendo de Formis et causis falsis, ut Crucis et Divortii. Quod vero ad Operativam attinet; illæ practicam aut designant; aut mensurant; aut sublevant. Designant aut ostendendo a quibus incipiendum, ne actum agamus, ut Instantiæ Potestatis; aut ad quid aspirandum, si

[1] That is, the constitution (or cosmos) of the universe.

detur facultas, ut Innuentes: mensurant quatuor illæ Mathematicæ: sublevant Polychrestæ et Magicæ.

Rursus ex istis instantiis 27, nonnullarum (ut superius diximus de aliquibus) facienda est collectio jam ab initio, nec expectanda particularis inquisitio naturarum. Cujus generis sunt Instantiæ Conformes, Monodicæ, Deviantes, Limitaneæ, Potestatis, Januæ, Innuentes, Polychrestæ, Magicæ. Hæ enim aut auxiliantur et medentur intellectui et sensui, aut instruunt praxin in genere. Reliquæ tum demum conquirendæ sunt, cum conficiemus Tabulas Comparentiæ ad opus Interpretis circa aliquam naturam particularem. Sunt enim instantiæ Prærogativis istis insignitæ et donatæ animæ instar, inter vulgares instantias comparentiæ; et ut ab initio diximus, paucæ illarum sunt vice multarum; quocirca cum Tabulas conficimus, illæ omni studio sunt investigandæ, et in Tabulas referendæ. Erit etiam earum mentio necessaria in iis quæ sequuntur. Præponendus itaque erat earum tractatus. Nunc vero ad adminicula et rectificationes Inductionis, et deinceps ad concreta, et Latentes Processus, et Latentes Schematismos, et reliqua quæ Aphorismo 21. ordine proposuimus, pergendum; ut tandem (tanquam curatores probi et fideles) tradamus hominibus fortunas suas emancipato intellectu, et facto tanquam majore; unde necesse est sequi emendationem status hominis, et ampliationem potestatis ejus super naturam. Homo enim per lapsum et de statu innocentiæ decidit, et de regno in creaturas. Utraque autem res etiam in hac vita nonnulla ex parte reparari potest; prior per religionem et fidem, posterior per artes et scientias. Neque enim per maledictionem facta est creatura prorsus et ad extremum rebellis. Sed in virtute illius diploma-

tis,[1] *In sudore vultus comedes panem tuum*, per labores varios (non per disputationes certe, aut per otiosas ceremonias magicas) tandem et aliqua ex parte ad panem homini præbendum, id est, ad usus vitæ humanæ subigitur.

[1] "Diploma" may be rendered "charter."

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END OF VOL. I.

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